17 MARCH 1961

METAL INDUSTRY

THE JOURNAL OF NON-FERROUS METALS

VOL 98 No 11

ONE SHILLING

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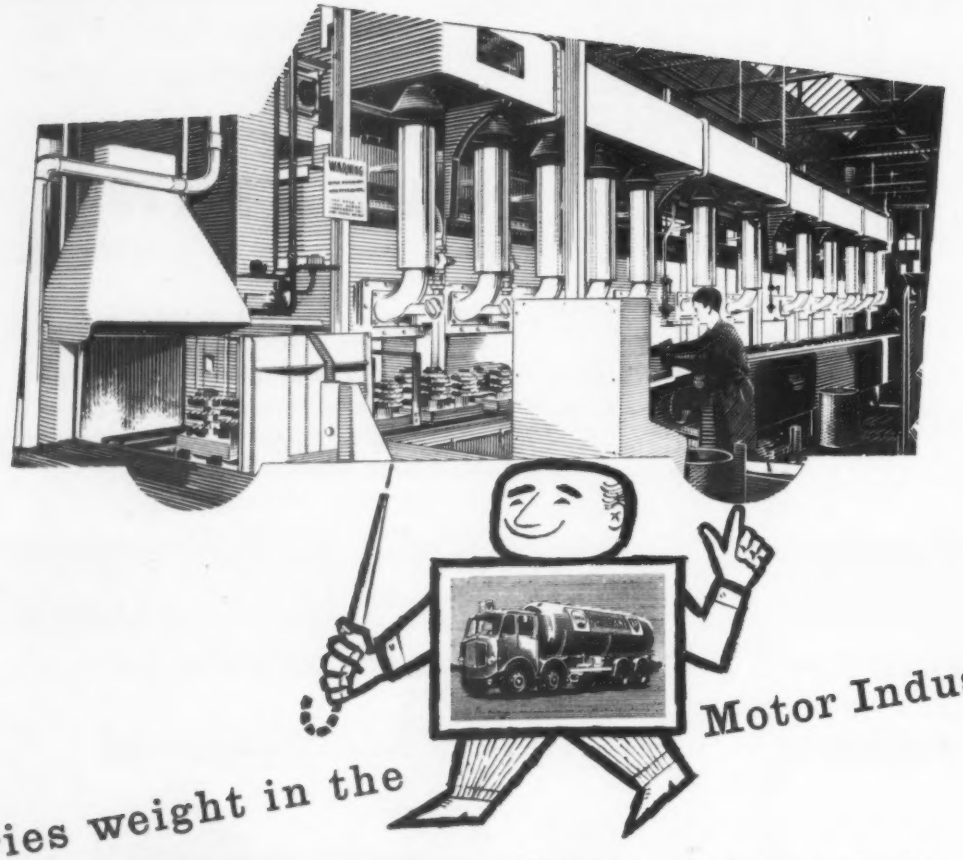

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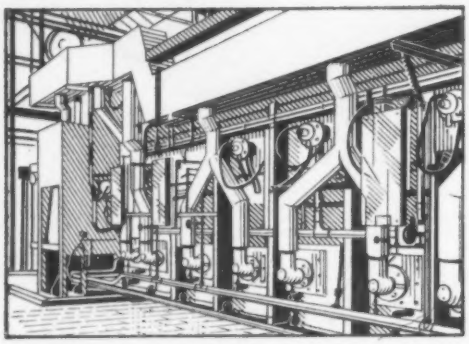

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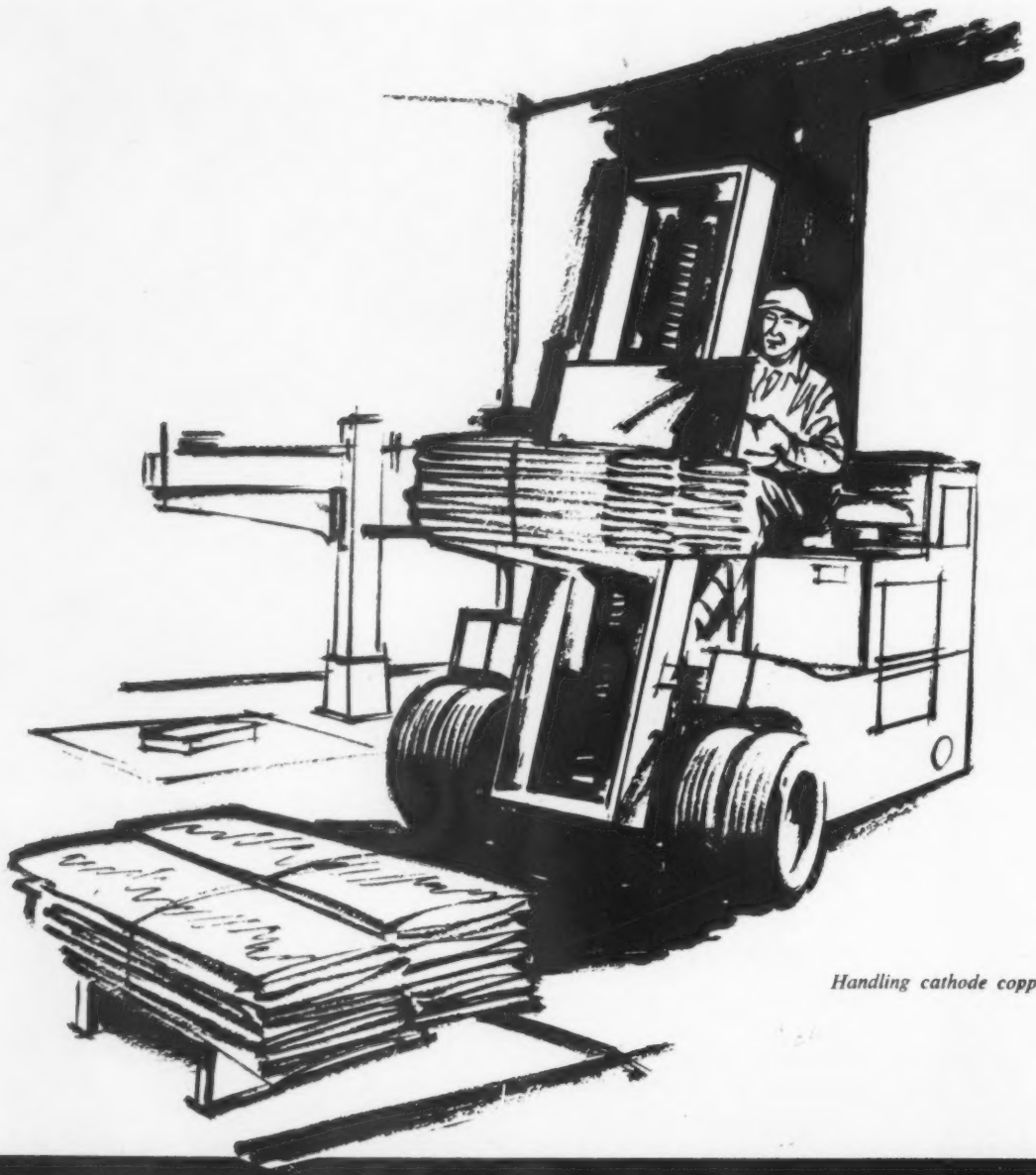

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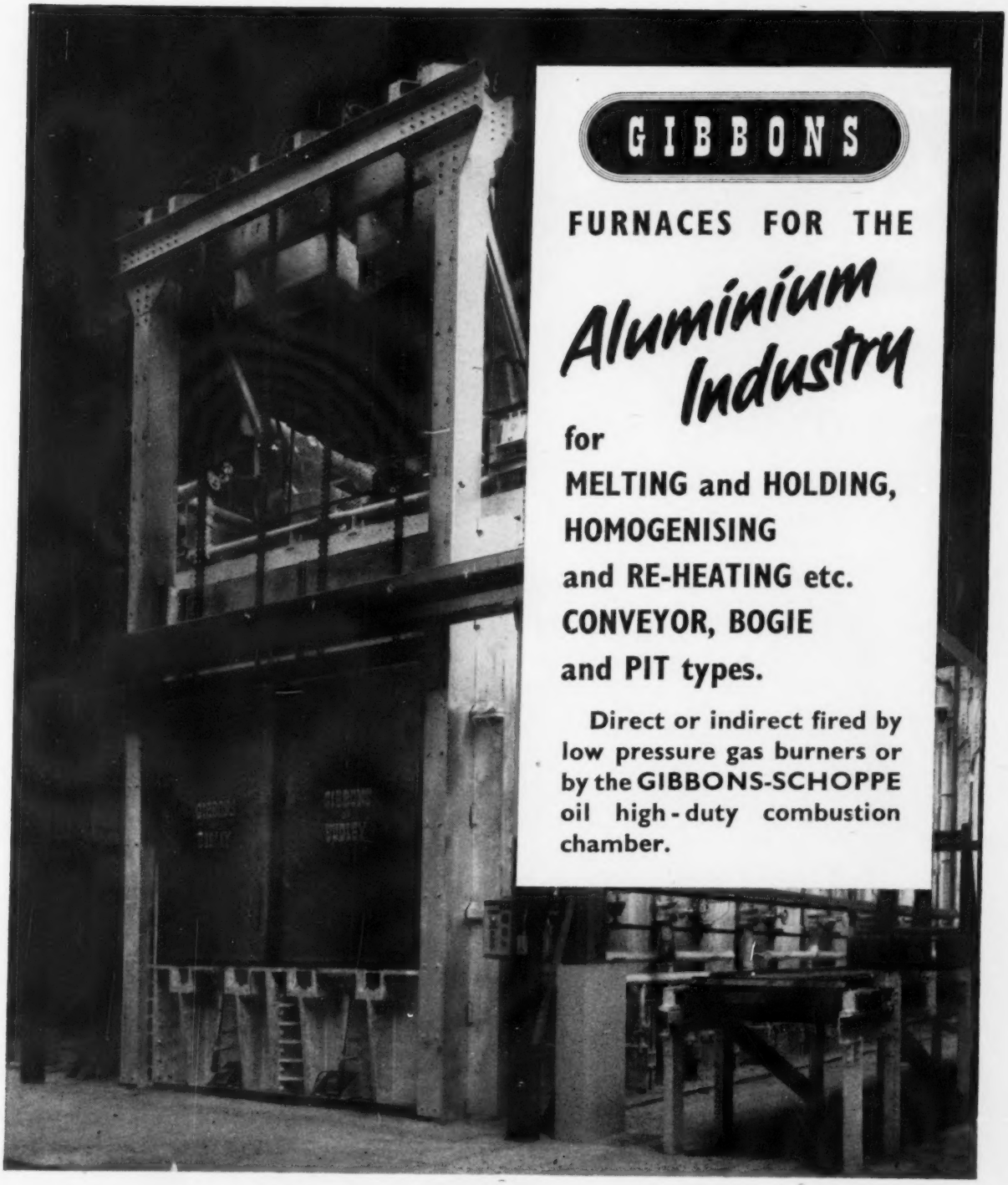

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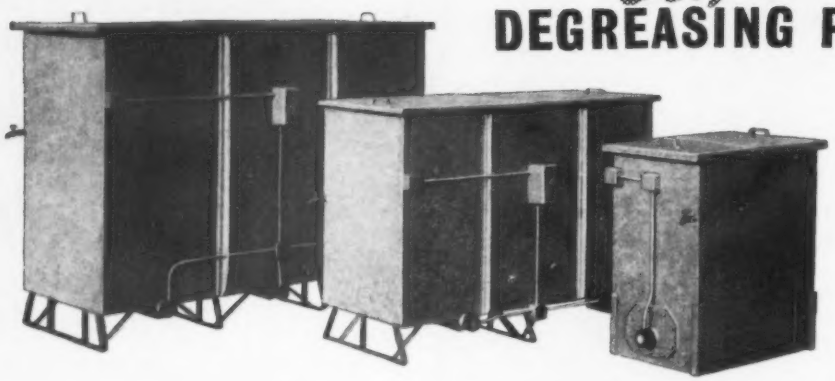

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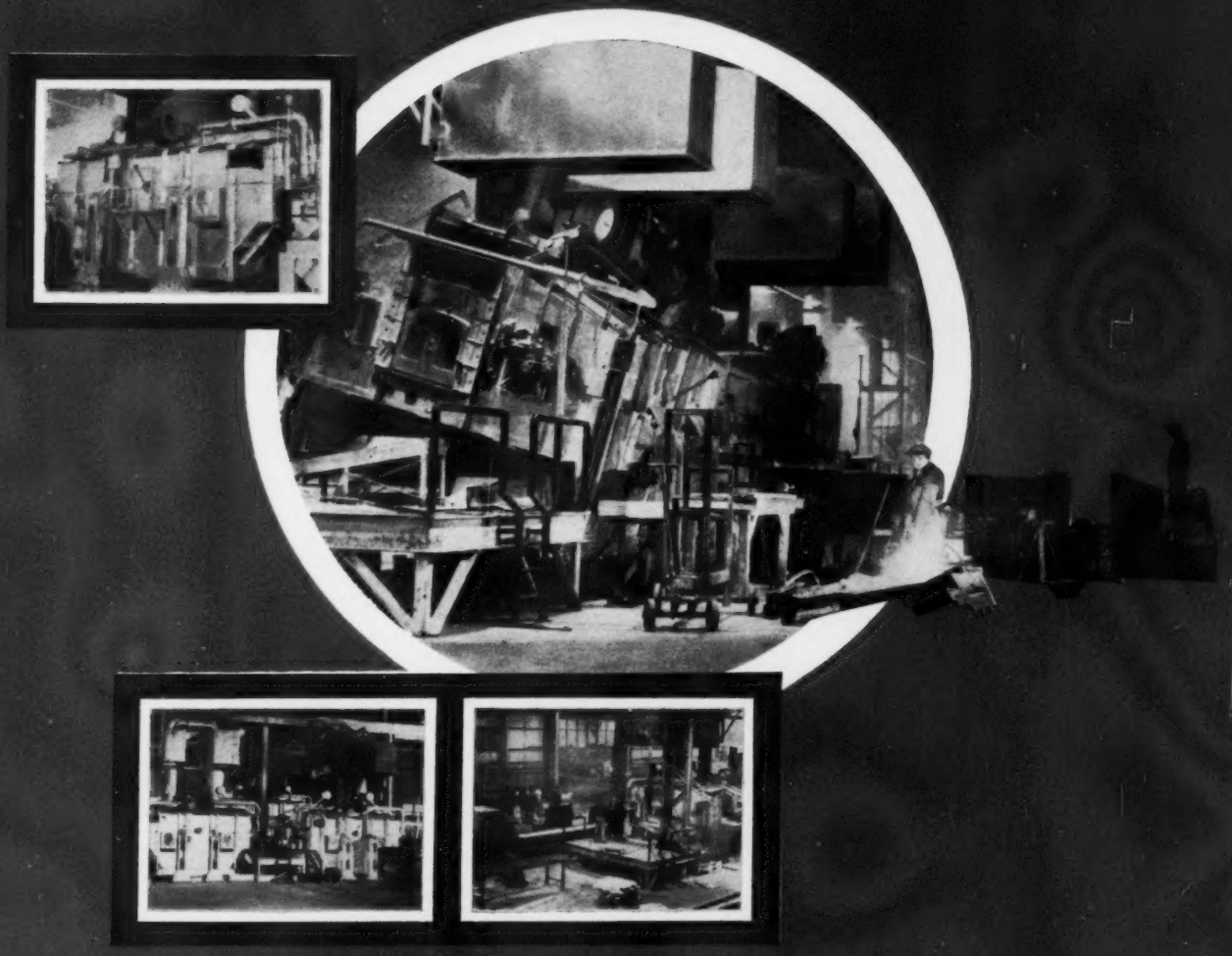

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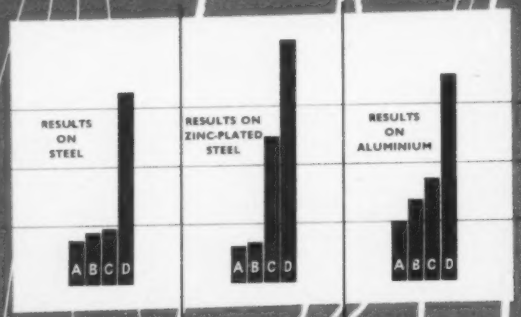

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CONTENTS

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METAL INDUSTRY

VOLUME 98 NUMBER 11 17 MARCH 1961

Powder Metallurgy

ALTHOUGH, of course, the powder metallurgy industry is much larger in America than in this country, there is every reason to believe that the trends are parallel. For this reason, some statistics compiled by the Metal Powders Producers' Association are of immediate interest. Thus, in 1960, consumption of iron powder in the United States reached almost 33,000 tons, of which about 500 tons were imported. This was about 2,000 tons lower than in 1959, which was a record year for the industry. It should be noted that only about 52 per cent of the total went into the manufacture of powder metallurgy parts. Capacity surveys show that powder producers can supply nearly twice the current demand, not counting expansion programmes contemplated for 1961. Non-ferrous powders (copper, brasses, nickel silver) reached about 19,000 tons, somewhat lower than the previous year. Of this amount, copper powders comprised 10,800 tons and copper alloy powders 4,000 tons, the balance representing flake powders not used for powder metallurgical applications.

The manufacturers of powder metallurgy parts for sale on the open market, when surveyed, revealed that they were operating at about 50 per cent of capacity but planning expansion, averaging about 20 per cent, in 1961. All are diversifying their markets as much as possible in order not to depend too closely on any single industry. It is interesting to note that, during the two-year period between 1958 and 1960, the usage of powder metallurgy parts (based on ferrous parts alone and not including self-lubricating bearings) showed a net gain of 84 per cent compared with malleable iron castings 37 per cent, die-castings 18 per cent, and grey iron castings 11 per cent. Approximately 850 million powder metallurgy parts were produced in 1960 for sale on the open market, a number which the industry can produce on a single shift basis.

Commenting on research activity in the industry, K. H. Roll, executive secretary, Metal Powder Industries Federation, said that "since an industry's growth is often a measure of its research activity, powder metallurgy is bound to progress". It is estimated that private industry alone is spending $3 million in powder metallurgy research, Federal support also being substantial. Between $1 million and $2 million is being spent by industry and government in developing powder metallurgy in nuclear engineering, and another $500,000 in the space programme. Some of the areas in which research effort is being expended by private industry in particular include development of new methods for fabricating powders into useful shapes, such as roll compacting, explosive forming, powder extrusion, isostatic pressing and continuous compacting. Parts fabricating techniques are also being investigated to improve properties, increase size capabilities and broaden design parameters. Other research projects include work on the fundamentals of powder metallurgy, dispersion strengthening, alloy effects, combination of metals and oxides in powder form, and coated powders.

In discussing the outlook for powder metallurgy, Mr. Roll predicted that the use of powder metallurgy parts would continue to surge upward. He felt that greater emphasis could be placed on quality and performance, and to a lesser degree on the cost savings aspects of powder metallurgy. While progress on the application of dispersion strengthening technology is expected to continue, its high cost and necessity for special techniques would limit its use to nuclear engineering and SAP-type aluminium. On the other hand, the construction of the first fully integrated plant for manufacturing copper sheet and tubing from copper powder (this column, 17 February) is an indication of faith in the future.

Out of the MELTING POT

Rounded

WHEREAS spherical metal shot can be produced in the case of suitable compositions more or less successfully by processes involving the solidification of drops of the molten metal, such processes are not very successful, or are even quite unsuitable with some metals, as well as for the production of small spherical particles. Even where applicable, such processes as, for example, atomizing, have the disadvantage of producing a material of a wide particle size range requiring separation of the desired size fraction. Furthermore, the perfection of the shape and the soundness of the particles obtained leave something to be desired where such applications as metal filter elements, small bearings and the balls of ball point pens are concerned. Much better results are obtained by a process involving the spheroidizing of irregularly shaped metal particles by heating. The suitably sized particles to be spheroidized (they may have a size within the range of 8 mesh to less than 150 mesh—U.S. Standard Screen) are mixed with a suitable amount of fine (less than 325 mesh) inert powdered refractory material and then heated to a temperature around their melting point. The amount of inert matrix material (graphite, quartz, silicon carbide, zircon, etc.) should be sufficient to "suspend" the metal particles and to keep them out of contact with each other during heating to prevent agglomeration. The loose mixture is heated in a reducing atmosphere or vacuum to bring about spheroidization of the metal particles. The temperature required for this will depend on the particular metal or alloy. Some metals, such as copper, will spheroidize at temperatures a little below their melting point, whereas others require heating to their melting point, or even somewhat higher, before adequate spheroidization will occur. After cooling, the spherical particles are separated by screening the mixture on a 325 mesh screen. Apart from providing this possibility of separation at the end of the process, the fine particle size of the inert matrix material is necessary to prevent the material imparting irregularities to the shape of the spheroidized metal particles.

Worth Encouraging?

ACCORDING to numerous professors, both in this country and perhaps more so in America, most science students they have to deal with find it difficult to express themselves in writing. Judging by the number of books and journal articles on the topic of "How to Write Technical Reports" and on similar topics, the self-same students, having obtained their degrees and found themselves jobs, still find it difficult to say what they have to say in writing. There is a widespread impression that scientists and engineers invariably prefer to get on with research work, designing, testing and similar practical tasks, rather than to sit down to write about their work, its results and their significance. There is no reason to doubt all the above evidence. At the same time, however, it contrasts strangely with the evidence of the growing volume of scientific and technical literature in the form of books, periodicals, Papers presented to learned societies, Symposia, etc. Admittedly, all this represents the end results of careful preparation, writing, editing, possible rewriting, checking, and proof reading. Nevertheless, it bears little evidence of any reluctance to sit down and report the results of research and other work. On the contrary, there are quite often signs of an eagerness to rush into print with results that definitely would have been improved had such eagerness been checked to delay publication until after a further six months' work had added to their value, with the ever-present alternative possibility that they might have been found not worth publishing at all. The discrepancy between the evidence from, as it were, direct observation and the evidence to the contrary derived from the growing volume of information that is published is perhaps to be explained by the not improbable conclusion that, in spite of its bulk, the latter is due to the activities of a relatively small proportion of the potential contributors. If that is the case, ought it not to be taken as a warning against aiding and abetting the balance to do likewise?

The Start

LIKE so many other processes in metals, the process of formation of pores or voids, which accompanies the evaporation of zinc from brass, has to start by nucleation. Nucleation depends on the presence of nuclei which may be part and parcel of the metal, i.e. various types of imperfections in the structure of the metal itself, or they may be particles of various types of impurities, e.g. particles of insoluble impurity metals or intermetallic phases, or non-metallic particles, such as oxide particles. In the case of the voids formed during the dezincification of alpha-brass, the evidence has pointed to their being heterogeneously nucleated, most probably by particles of zinc oxide. This is deduced from the fact that vacuum remelting of the brass (which reduces the oxygen content) and also zone melting (which increases the purity of the metal) both result in a drastic reduction in the number of voids formed, as compared with the number formed when the same amount of zinc is evaporated from brass of commercial purity. Nothing in this world being perfect, however, some voids develop even in very pure brass, the nature of the nuclei responsible for their formation in such cases being uncertain. In the initial stages of their growth, the voids, within the confines of a given grain, have the form of narrow, equally oriented fissures. Further growth causes the development of regular, primarily cubic, boundaries. Small angle X-ray scattering from thin, coarse-grained and single-crystal specimens of 70:30 brass has been used to study the orientation and to evaluate the size of these voids. Prior to dezincification, the small angle X-ray scattering from such specimens was negligible. Void formation was brought about by vacuum heating at 800°C. for 10 min. Small angle X-ray scattering from these specimens, and its variation as the crystal was rotated relative to the slit, showed that the fissure-shaped voids were oriented parallel to the (110) plane of the crystal and had a size of 15-20Å by about 1,000Å. The observations also suggested that the zinc oxide nuclei of these voids are present probably in the form of flakes which lie parallel to the (110) planes of the metal crystal. In this connection it is interesting to note that there does, in fact, exist a structural correspondence between the (100) plane of the wurtzite modification of zinc oxide and the (110) plane of alpha-brass.

Skinner

RECENT DEVELOPMENTS FOR THE NON-FERROUS METAL INDUSTRY

Oil-Fired Furnaces

By J. A. TAYLOR, B.Sc.(Eng.), A.M.Inst.F.
(*Fuel Oil Dept., Shell-Mex and B.P. Ltd.*)

(*Concluded from* METAL INDUSTRY, 10 *March* 1961)

WHILST most of the fuel oil used in this country for melting zinc is used in the galvanizing industry, it is also used for reclaiming and refining of zinc. A furnace for this purpose, of 50 tons capacity, is shown in Fig. 15. It has two chambers, one for melting, of 40 tons capacity, the other, of 10 tons capacity, for holding. It is end-fired with light fuel oil, using medium pressure air burners, and works in conjunction with a continuous casting unit, which can be seen to the left of the furnace in the illustration. Automatic temperature control, working from bath temperature measurements, is provided. It has a rated output of 3 tons/hr. and a fuel consumption of 4·3 gal/ton whilst casting. On stand-by, the fuel consumption averages 5½ gal/ton.

Fig. 15—Baggeler furnace for melting zinc *Courtesy Enfield Rolling Mills Ltd.*

Aluminium Melting

One of the largest uses of fuel oil in the non-ferrous field is the re-melting of aluminium in works where a variety of sheet, bars, etc., are subsequently rolled. These furnaces are of the direct-fired reverberatory type, having about 20 tons capacity, but development is towards larger units of 50 tons capacity with fast melting rates. This, in turn, has resulted in an increased usage of air preheat and higher quality refractories, one typical new design using 500°C. air preheat and 55 per cent alumina brick for the roof and side walls. This unit is expected to melt at a rate of 10 tons/hr. for a fuel consumption of at least 18 gal/ton.

The introduction of preheated air to smaller existing 10 ton furnaces, together with the use of self-proportioning low pressure air burners, is reported to have resulted in fuel consumption varying between 18 and 24 gal/ton, these particular furnaces being equipped with automatic furnace pressure control.

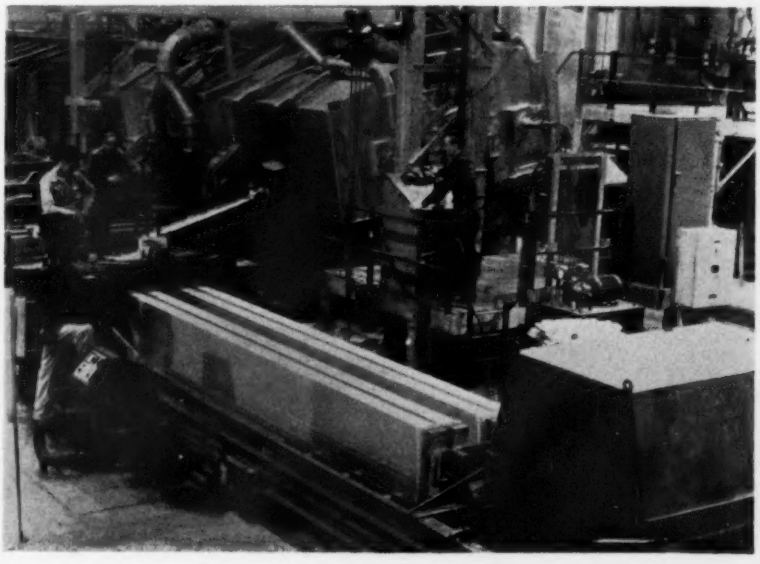
Following melting and alloying, the metal is usually transferred to holding furnaces, from which it is cast into slabs. The demand for accurate rates of pouring for casting has led to the development of the Lip Axis Tilting Holding Furnace shown in Fig. 16. These furnaces have been supplied for holding capacities ranging from 3 to 20 tons and for one-way and two-way tilting.

The furnaces comprise a steel plate casing lined with special refractory to hold the aluminium, the side walls above the bath level and crown being of insulating brick.

Burners using gas oil are provided at one or both ends of the furnace, usually controlled on the high/low or on/off system, it having been found unnecessary to provide proportioning control, due to the large body of heat in the aluminium and the small amount of heat required from the burner. If a small amount of melting is required, some of the burners are of increased capacity to provide the necessary temperature head. Skimming doors are provided above the end of the bath, usually hand-operated.

Accuracy of control of tilting is obtained by using oil/hydraulic power units. A single acting cylinder is positioned under the furnace, and the

Fig. 16—Lip axis aluminium holding furnace [*Courtesy Stein and Atkinson Ltd.*



trunnions for tilting are on the same plane and distance from the centre line of the furnace as the pouring spout. Control of tilting is by two flow controllers, one of which is used to pass the oil to the tilting cylinder at a controlled rate, whilst the second is used to leak off the first flow controller, hence giving great accuracy of tilt. Having once set the two flow controllers, the furnace will continue to pour at a given rate until the bath is emptied. This can be repeated at will by setting the flow controllers in the same position.

An alternative to melting and then casting from holding furnaces is shown in Fig. 17. This embodies the principle of continuous casting. Two oil-fired furnaces work in tandem and thus whilst one furnace is being used for pouring, the second furnace is rapidly melting down its charge ready to bring it into use.

The metal is taken from the furnaces by means of a special float valve which maintains a constant level of metal in the transfer launder.

The furnaces are equipped with low pressure air burners, and incorporate automatic control of metal temperature. Those illustrated ensure a continuous throughput of 6,000 lb. of aluminium per hour. An overall fuel consumption of 16 gal/ton is reported.

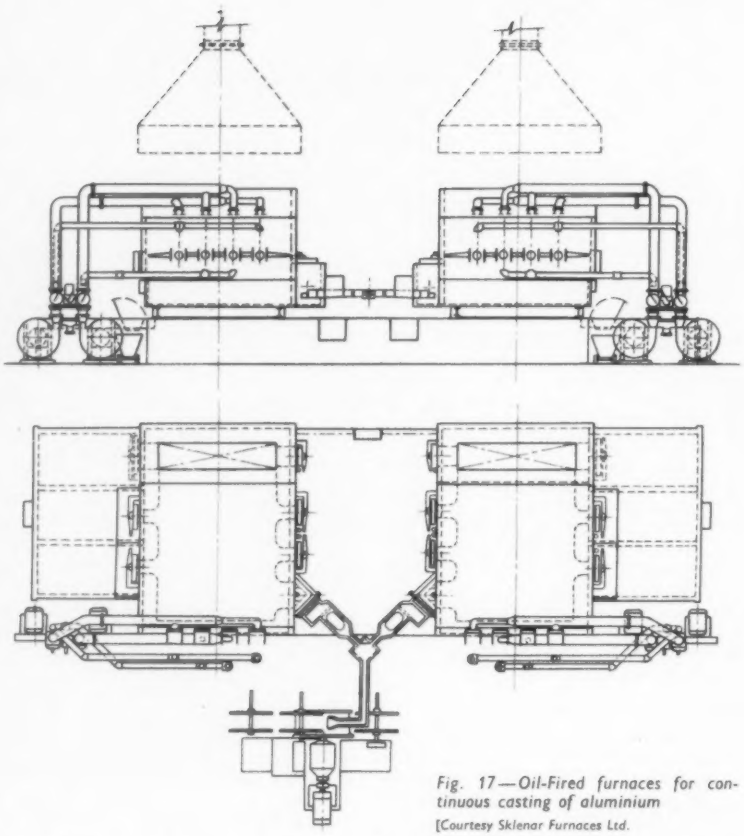


Fig. 17—Oil-Fired furnaces for continuous casting of aluminium
[Courtesy Sklenar Furnaces Ltd.

Bronze Melting

A 25/30 ton oil-fired bronze melting furnace, developed for marine foundries manufacturing propellers, is shown in Fig. 18. It fires simultaneously from each end and has a central flue. The flue covers are hydraulically controlled, which enables outsized scrap, such as feeders from large propellers (of the order of 7 ft. 6 in. diameter and 10 ft. long), to be lowered into the furnace in one piece without subjecting the lining to excess thermal shock.

The full charge of metal is melted in approximately two hours, with oil consumptions averaging 15·6 gal/ton of metal melted.

Billet Heating

A continuous copper billet heating furnace, using walking beams for moving the billets through the furnace, is shown in Fig. 19. It is 38 ft. long, is end charged, side discharged and is an integral part of a new fully-automatic copper rod rolling mill. It is, in fact, a double furnace, each unit having a throughput of 15 tons/hr. There are 12 Schieldrop self-proportioning low pressure air burners, arranged five per side, firing over the wire bars with one each side firing into an underground combustion chamber below the walking beams at the discharge end. Waste heat recovery is incorporated using a Shack recuperator giving 250° C. air preheat. The original form of the furnace is shown in Fig. 19, the protective arch being of silicon carbide. The furnace has now been converted to direct firing by removing the arch, and operates quite satisfactorily on heavy fuel oil. Furnace temperature control is by electronic potentiometer controlling hydraulic regulators which actuate the burners through mechanical linkages. Automatic furnace pressure control and combustion air pressure control are fitted, the furnace atmosphere—maintained neutral to slightly oxidizing—being recorded by a duplex combustion analyser.

Running at full load, the fuel consumption is 57 gal/hr. per furnace, or 3·8 gal/ton, whilst the consumption is 25 gal/hr. when holding. The overall weekly consumption, including standing time during mill breaks and between shifts, averages 5 gal/ton.

Heat-Treatment

The advent of the oil-fired radiant tube has made possible the successful application of oil to installations where open flame designs were undesirable, because of furnace atmosphere considerations and where muffle or semi-muffle types were relatively inefficient. Such an application is the heat-treatment of aluminium alloys where an atmosphere free from sulphur compounds and excessive moisture is required. Such heat-treatment takes place in the range 500°-550° C., where heat transfer by radiation becomes less important than that obtained by convection, and in these cases the technique used is to pass air over oil-fired

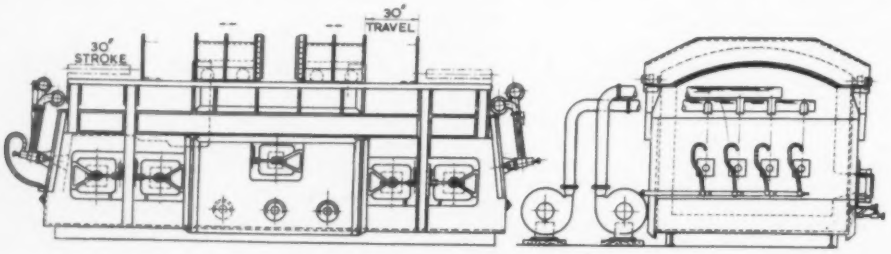
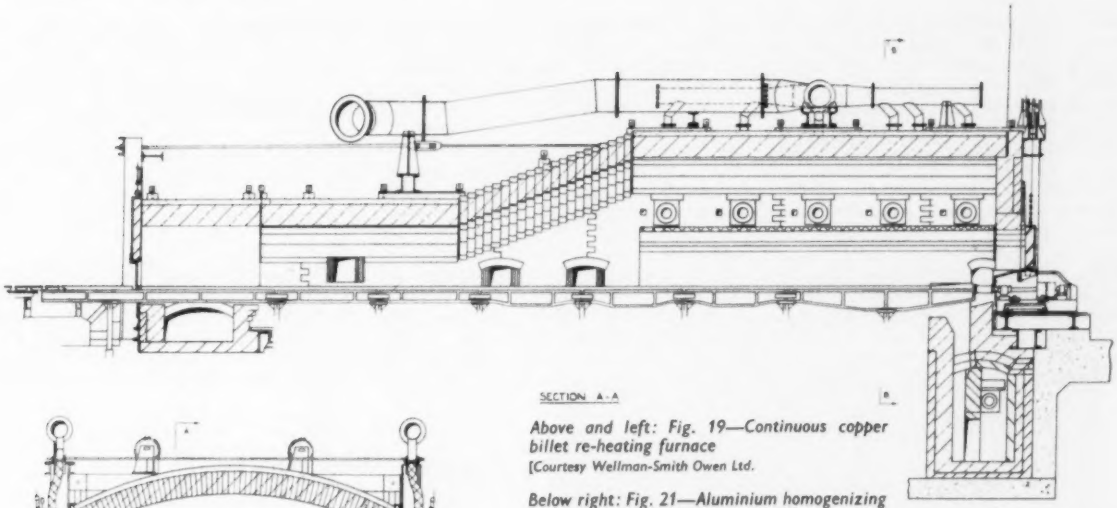
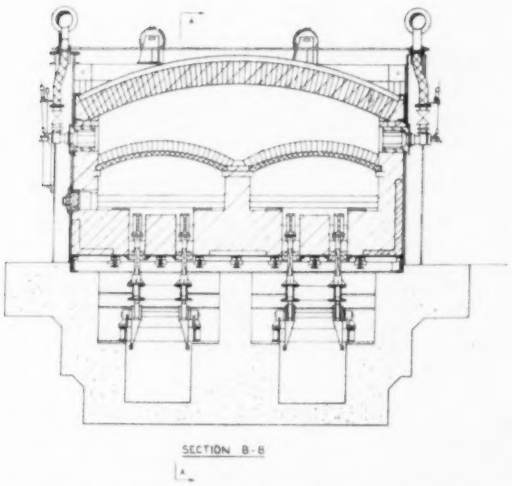


Fig. 18—25/30 ton bronze melting furnace
[Courtesy Sklenar Furnaces Ltd.



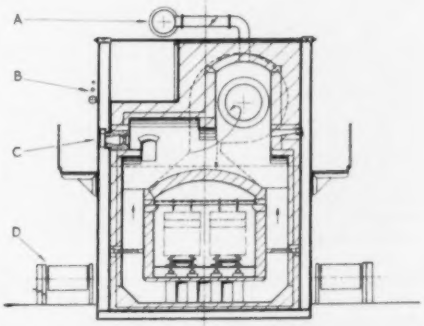
SECTION A-A



SECTION B-B

Above and left: Fig. 19—Continuous copper billet re-heating furnace
[*Courtesy Wellman-Smith Owen Ltd.*

Below right: Fig. 21—Aluminium homogenizing furnace with Schoppe combustion unit
[*Courtesy Gibbons Bros. Ltd.*



A—Duct. B—Air and oil supplies. C—Gibbons-Schoppe combustion chamber. D—Return conveyor

radiant tubes, the air being circulated through the furnace by fans. This method allows furnace atmosphere control to be achieved if required.

Permission to publish details of this type of furnace has not been obtained but Fig. 20 shows the principle employed, in this instance to an aluminium soaking pit.

The Schoppe combustion chamber has been described earlier in this article. It has been applied to aluminium homogenizing furnaces (Fig. 21). Until recently, the large proportion of homogenizing furnaces have been either elec-

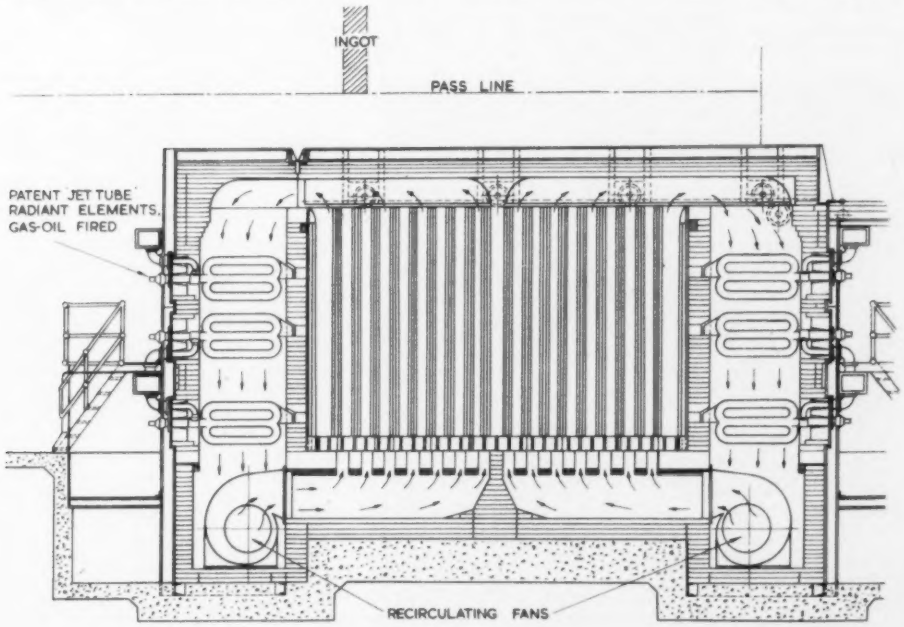


Fig. 20—Aluminium soaking pit employing oil-fired radiant tubes
[*Courtesy Incandescent Heat Ltd.*

trically heated or fired by gas and, over the years, the advantage of recirculated furnace atmosphere has been established. The velocity of the recirculated air has been found to be an important feature in ensuring uniformity of charge temperature, and now volume changes up to 60 or even 80 per minute are provided. In the past, an oil-fired furnace working under such conditions, where furnace pressure and high velocity are involved, required one or more refractory combustion chambers to be incorporated in the furnace design. These combustion chambers not only build up the initial capital cost, but, to some degree, affect the flexibility of the furnace and increase maintenance costs. Using high intensity combustion chambers, the products of combustion are applied direct into the recirculating system of an homogenizing furnace so that the products are mixed with re-cycled furnace gases and blown by a series of hot gas fans back into the furnace chamber through louvres arranged above the charge being pushed through. The gases are withdrawn from the furnace through flues arranged at the bottom of the chamber, then returning to the hot gas fan. In addition, a small bleed-off of gases is provided, compensating for the addition of products of combustion. Under these conditions, working with gas oil, the excess air is as little as 5 per cent.

Conclusion

Oil fuel has been applied successfully to high and low temperature processes in the non-ferrous metal industry. Because of recent developments, its wider use in the industry can be expected, particularly in applications operating at relatively low temperatures and where high intensity and two-stage combustion can be employed.

Acknowledgments

The author thanks the directors of Shell-Mex and B.P. Ltd. for permission to publish this article, Mr. A. B. Pritchard for constructive criticism, and those firms who kindly supplied details of the processes and furnace designs.

Annealing Brass Strip

FOUR new heat-treatment furnaces have been installed at Earle, Bourne and Company Limited as the latest step in the company's development project. Designed and built by G.W.B. Furnaces Limited, of Dudley, the four electric batch furnaces will be used for the intermediate and final annealing of brass strip. The complete installation comprises not only the furnaces but also a heavy duty steelworks - type turntable charging machine of Gibbons-van-Marle design and five loading tables.

The coils are annealed at a temperature usually in the range of 500° to 600°C., withdrawn from the furnaces by the Gibbons - van - Marle charging machine and allowed to cool to room temperature. The company hopes to install a cooling tank in the near future so that the coils can be quenched immediately after leaving the furnace.

The heating chambers are 20 ft. long × 5 ft. wide × 3 ft. 6 in. high to crown of door opening. Each furnace is rated at 342 kW in three zones and is designed for operating up to a maximum temperature of 750°C. Two of the furnaces are equipped with reduced rating input control so that they may operate, with very close temperature uniformity, at lower temperatures for charges requiring stress-relieving.

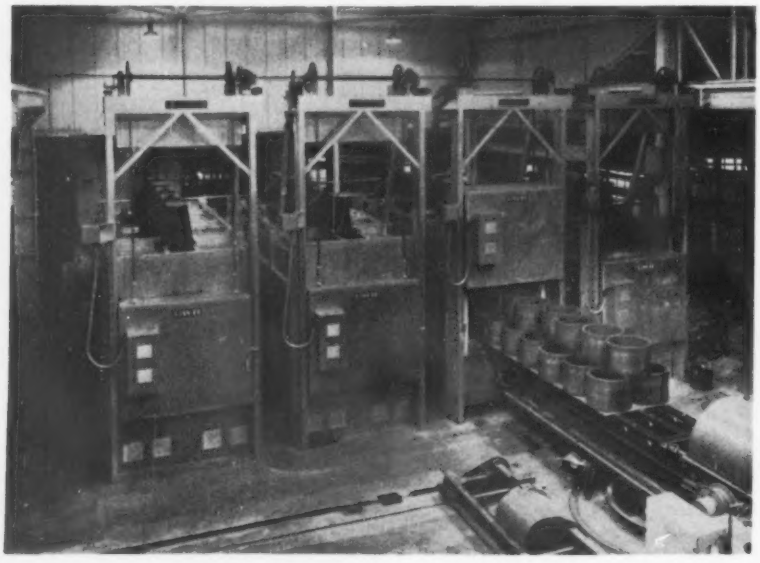
The hearth incorporates three grooves to accommodate the arms of the charging machine, the piers being formed in single-piece, specially-moulded firebrick blocks. These piers are topped with heavy cast 24/12 nickel - chromium alloy heat - resisting steel plates, as are the wells of each groove which guide the chargers arm rollers. Arranged in sinuous form and fitted under the arched roof and in the hearth of the heating chamber, the heating elements are made from 80/20 nickel-chromium strip. Door elements are in the form of nickel-chromium wire coils.

Each furnace is fitted with a counter-balanced door framed with mild steel and refractory faced. The drive for the door lift is obtained from an electric drive unit consisting of a motor transmitting through the necessary reduction gear box and spur wheel drive on to a main shaft, the latter being fitted with sprockets and robust chains attached by lugs to the door.

Five waffler type air circulating fans are fitted in the roof of each chamber.

Each furnace's electrical equipment comprises a switchgear cubicle working in conjunction with an Ellison oil immersed circuit breaker, and the temperature control is from three Electroflo indicating controllers and an Electroflo three-point recorder. Safety contacts are fitted to these recorders so that the main electric supply is cut off automatically in the event of accidental overheating, so isolating the furnace.

Brass strip coils being withdrawn from one of four G.W.B. batch furnaces at Earle, Bourne and Company Limited. Each furnace is rated at 342 kW in three zones



Electro-Erosion Machining

INTENDED as an overall survey of the technique, developments and industrial applications of electro-erosion machining, the book "The Electro-Erosion Machining of Metals", by A. L. Livshits, has been translated from the Russian by E. Bishop. It outlines the physical conditions for cutting by electro-erosion, the generation of current pulses, automatic control of the machining process, electro-technological characteristics, and it describes four types of machines for accurate electro-erosion machining.

While this book should be of interest to manufacturers and designers of electro-erosion machines, its limitations are that it is concerned with Russian developments and the illustrations of machines, and diagrams, are also of Russian origin.

Published by Butterworths, 4-5 Bell Yard, London, W.C.2, in association with the Department of Scientific and Industrial Research, it is priced at 30s.

Finishing Supplement

Organic and Metallic Finishes

By R. J. BROWN, A.I.Mech.E., F.I.M.
(*Chief Materials Engineer, British Motor Corporation*)

(*Continued from* METAL INDUSTRY, 10 *March* 1961)

WEATHERING resistance is of vital importance; indeed, to the purchaser, the principal requirement of any organic finish is durability, and tests which set out to assess durability give rise to the greatest discussion and the least agreement as between paint maker and user, in view of the fact that it is necessary for such tests to accelerate any breakdown which may occur in service.

Let us first consider the faults to which organic finishes are subject in the field, and which have not, so far, been referred to: (a) colour change; (b) loss of gloss; (c) chalking (as distinct from loss of gloss); (d) crazing and cracking (Figs. 14-17).

These are not listed in any particular order, and it is possible that many users of paints would consider that blistering, to which we have already referred, is a far more serious problem than any of the above faults, be the material a domestic paint or a motor body finish.

Unfortunately, none of the weatherometers so far developed has been successful in reproducing colour change; this is a subject which is being actively pursued in our own laboratories at the present time (Fig. 18), but the other weathering defects, which are, in general, more serious to the owner, are readily reproduced.

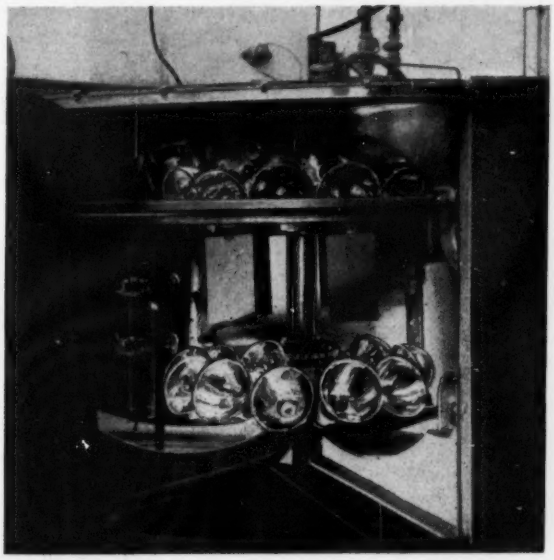


Fig. 18—The B.M.C. weatherometer for assessment of the resistance of paint films to weather

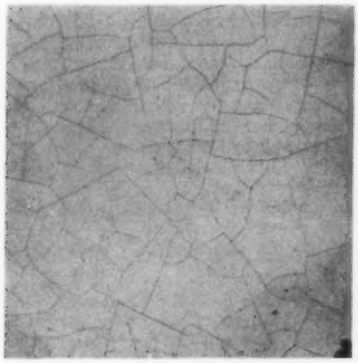


Fig. 14—Cracking

Some examples of defects arising in service

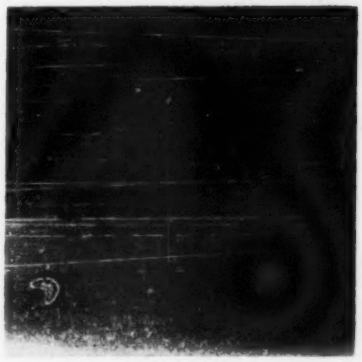


Fig. 15—Line checking

Fig. 16—Crows-foot checking

Fig. 17—Checking

Chalking is a self-descriptive term indicating surface deterioration with the production of a non-reflective surface with a film of powdery matter; this breakdown is associated either with binder formulation or with pigment type, and is more prevalent with cellulose lacquer finishes than with stoving finishes. Loss of gloss may be associated with chalking or with micro-crazing, but is not necessarily due to either effect; in many instances it may result from degradation of the surface with the formation of sub-microscopic pits.

Cracking is, in these days, a relatively rare occurrence, but micro-checking is less unusual, and other forms of checking are also experienced. These forms of breakdown are generally related to formulation of the finish, although cracking may be due to excessive coating thickness, and all the types of breakdown referred to are serious to the owner in that although the finish can, in some instances, be re-surfaced with a cutting compound followed by polishing, breakdown again occurs in an extremely short time, the actual period depending upon the climatic conditions.

Before discussing test procedures,

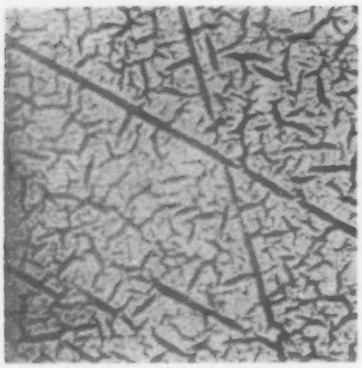
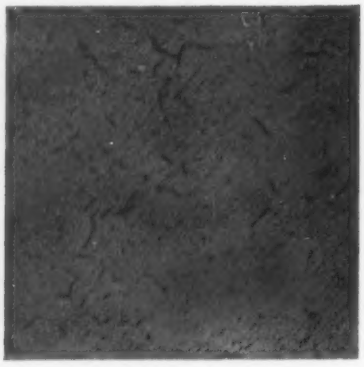


Fig. 19—Synthetic coating exposed for 6 months—Singapore

Fig. 20—Stoving synthetic finish exposed for 6 months—Durban

Fig. 21—Stoving synthetic finish exposed for 6 months—Durban (different season)

Fig. 22—Synthetic finish after accelerated test



some consideration of the climatic conditions associated with paint failures is worthwhile. The paint makers who supply the motor industry both in this country and the U.S. place pathetic faith in the results of outdoor exposure in Florida. There is, of course, every reason to accept the belief that conditions in that part of Central America are extremely arduous to organic coatings, but insufficient consideration is given to the variations which can occur in climatic conditions from year to year even in such a comparatively consistent location. Our own experience on a number of occasions in the past has been that coatings which have passed satisfactorily the Florida exposure test have failed lamentably in other locations, so we have based our own test programme on an endeavour to match the worst failures which occur in service, regardless of the location of failure, which may well vary from year to year. Such a test should of necessity be of very short duration, but should embody, as far as possible, the components of the weather, i.e., water both precipitated as rain, and water condensed as a result of humidity effects, and solar radiation involving infra-red and ultra-violet radiation. It is obvious that if the natural climatic conditions are matched, the weathering test would take a very long time in the case of a satisfactory finish, but when breakdown is speeded up the user enters into a field of complexities.

Consider some of the typical variations which occur in climatic conditions at different locations on the earth's surface; not only does the humidity vary between very wide limits but so also does the temperature. In particular, the conditions in West Africa are extremely severe, with shade temperatures up to 105°F. and solar temperatures up to 175°F. at the time of recording; additionally, during the cooler periods the relative humidity may be up to 100 per cent for considerable periods, and it is this combination of intense solar radiation with periods of high humidity which plays havoc with organic finishes. The association between solar temperatures and vehicle temperatures as recorded in India is of interest, the skin temperature of the vehicles at the time being nearly 134°F., with a solar temperature of only 109°F. and a shade temperature of only 92°F. It will be appreciated that with solar temperatures as high as 175°F., as recorded in West Africa, the skin temperature, and therefore the temperature of the organic finish of a motor car, is likely to be in the region of 200°F., and temperatures of 180°F. have been consistently recorded in some areas. The temperature reached within a vehicle is also of importance, and may be as high as 180°F., which, in association with direct sunlight, even though the latter may be filtered through the window, thus reducing the ultra-violet radiation, will have an extremely adverse effect on the rather more delicate finishes such as the clear lacquer used on internal wood trim. The absorption effects of coloured finishes can also affect the temperature reached by the finish.

In establishing the B.M.C. accelerated weathering test procedure, consideration was given to the above factors and to comparisons of the ultra-violet

Fig. 23—Cellulose finish exposed for 6 months—Singapore

Fig. 24—Cellulose finish exposed for 6 months—Durban

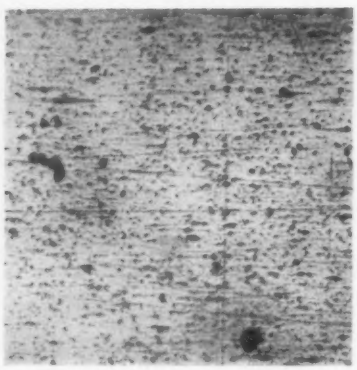
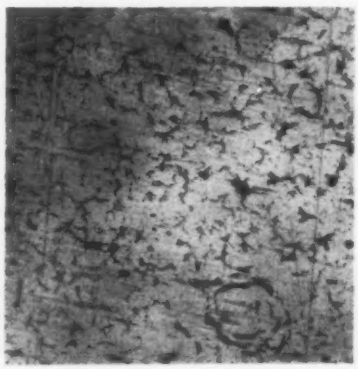


Fig. 25—Cellulose finish after accelerated test



spectra of solar radiation and of available ultra-violet light sources. After prolonged exposure cycles combining the effects as separate constituents of heat, humidity, and ultra-violet light, manipulating the panels manually between each constituent, associated with overseas weathering at selected sites known to cause trouble with the organic finishes applied at the time, sufficient data became available to build a weatherometer incorporating the necessary components to give virtually parallel breakdown to that occurring at the worst of the overseas locations, which was not necessarily the same location year after year. This unit was described in some detail several years ago, and has also been described in a published article.[5] A comparison of typical test panels exposed at overseas locations and in this weatherometer may be worth while, indicating as they do a reasonably close correlation in the breakdown which has occurred (Figs. 19-25).

Engine Finishes

These are applied to iron castings and steel pressings, but the materials are assessed on a conventional basis, using a simple bend test on a tin plate substrate in accordance with D.T.D.517A for the assessment of adhesion. The most important requirement is resistance to the effects of oils, fuels, and those fluids used during manufacture, as certain of the finishes are applied to castings in the rough state after shot blasting, but prior to machining. The effect of such fluids is assessed by the following tests, using a shot-blown cast iron test plate:

Crankcase sealers and external prime coats—

No flaking, cracking, softening or colour change is permitted after the following immersion tests:

In regular grade petrol for 2 hr. at room temperature.
In SAE.20 engine oil for 4 hr. at 95°C.
Trichloroethylene boiling for ½ hr. immersion in 1·5 per cent.
Sodium hydroxide boiling for 20 min.

External finishing coats—

No flaking, cracking, softening or colour change after immersion of half the test panel in the following:
Regular grade petrol for 2 hr. at room temperature.
SAE.20 engine oil for 4 hr. at 95°C.

Editorial Note—On page 169 of our issue of March 3, the minimum thickness required for a stoving finish was given as 0·045 in.; this should, of course, have read 0·0045 in.

Reference

[5] A. J. Birch; *Prod. Fin.*, 1955. Jan.

(To be continued)

Men and Metals

Recent news from the International Nickel Company of Canada Limited is that **Mr. Ivon A. Bailey** has been elected a vice-president and **Mr. John O. Hitchcock** an assistant vice-president of the company, effective as from April 10 next. Mr. Bailey will remain chairman and chief officer of the International Nickel Company (Mond) Limited, and of Henry Wiggin and Company Limited. Mr. Hitchcock remains managing director of the International Nickel Company (Mond) Limited and deputy chairman of Henry Wiggin and Company Limited. He will also continue as second chief officer of both companies.

Appointed Scientific Attaché to the British Embassy in Paris, **Mr. Richard Melville,** B.Sc., M.Sc., has been with the Department of Scientific and Industrial Research since joining the Geological Survey and Museum in 1938. In his new post he will advise the British Ambassador in France on scientific matters and report on French scientific and technical development in the civil field.

The first award of the Sir Walter Puckey Prize was made to **Mr. L. C. Lambert,** Dip.Tech.(Eng.), at a meeting of the Welsh Region of the Institution of Production Engineers, held in Cardiff on Friday of last week. This prize is an annual award of £50, open to first-year students taking diploma in technology courses in any branch of engineering in any college in England and Wales. The presentation was made by Sir Walter Puckey to Mr. Lambert.

An announcement from British Insulated Callender's Cables Limited is to the effect that **Mr. J. Varley** and **Mr. G. H. Parr,** refinery manager and sales manager respectively of British Copper Refiners Limited, of Prescot, have been appointed directors of that company.

Chief metallurgist to Specialloid Limited, **Mr. E. V. Dewhirst** has been awarded the Insignia Award of the City and Guilds of London Institute for his thesis on "The Surface Treatment of Piston and Liner Assemblies for Internal Combustion Engines".

It is announced that **Mr. D. C. M. Salt** has been appointed to the board of Monsanto Chemicals. He joined the company in 1935 and has been director of sales since 1959.

Cold Extruded Titanium

LOW-COST manufacture of titanium fittings has been made possible with precision cold extrusion techniques developed by Battelle Memorial Institute.

One titanium part used in a pilot investigation at Battelle was a No. 10 size hexagonal nut for MS-type aircraft quality flareless tube fittings, normally produced in steel or aluminium entirely on automatic screw machines. Production of titanium fittings by machining has been so costly that their use has not been justified. The Battelle process has cut this cost almost in half.

Full-size hexagonal cups were backward extruded in a single operation from solid cylindrical AMS 4902 unalloyed titanium billets 1 in. diameter by $\frac{3}{8}$ in. thick. The operation involved a 55 per cent extrusion reduction and required a pressure of about 335,000 lb/in^2. The hexagonal cups, measuring 1 in. across the flats by 1 in. long, with $\frac{13}{32}$ in. bore, were then finish-machined and threaded on a screw machine.

Not only is the starting billet used in cold extrusion only half the weight of the one needed for screw machining, but it can also be cut from round barstock instead of the more expensive hexagonal barstock. Material cost for an ASM 4902 titanium No. 10 nut produced by cold extrusion with screw machine finishing amounts to $0.64, compared to $1.52 for a nut produced exclusively by screw machining operations.

Comparing the overall manufacturing costs, pre-forming the nut by cold extrusion and finishing on an automatic screw machine yields a net cost saving of 48·5 per cent over the conventional method of making the nut completely by screw machine methods. Other hydraulic fittings and female fasteners should be adaptable to fabrication from titanium by cold extrusion, making titanium parts more competitive with other metals.

In addition to significant cost savings on material and labour, the cold extrusion process also offers the advantages of (1) considerable strengthening through work hardening, and (2) excellent surface finishes and close dimensional control in the as-extruded condition. Cold extrusion has been applied mostly to aluminium, brass and steel. The aim of the current investigation was to establish the necessary basic technology for cold extruding actual parts from titanium on a commercial basis. The studies were directed mainly toward reducing the pressure requirements. The variables studied were punch design, billet shape, and lubrication.

RAPID AND ECONOMIC PREPARATION BY GAS-SOLID FLUIDIZATION

Investment Casting Moulds

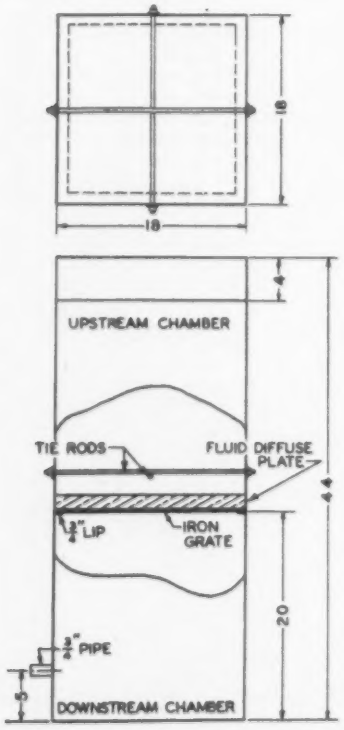
In this article a means of fluidizing particles for rapid investment of moulds is described. The original report, of which this article is a condensed version, was based on work carried out by F. Quigley and E. Deluca at the Rodman Laboratory, Watertown Arsenal.

IN the manufacture of a standard investment casting mould, the initial step is the coating of the cleansed pattern with a ceramic slurry and subsequent coating of this slurry with solid, granular particles. Investiture of the resulting form then follows. The more recently developed processes for the production of an investment casting mould incorporate the application of multiple, alternate coats of slurry and solid particles to the pattern.

The conventional method of solid particle coating is to direct, manually or mechanically, a stream of particles on to the pre-wetted form by action of gravity. This method is time-consuming, requires an excessive amount of manipulation of the form by the operator, and, in the case of complex patterns, does not readily yield a uniform particle coating.

Coating processes which utilize the unit operation of gas-solid fluidization have found wide acceptance by the plastics industry.[1,2] Solid fluidization is the process of imparting to a particle bed a state of continuous agitation. Gas-solid fluidization is accomplished by passage of a gas up through a bed of solid particles. The bed, in its agitated or fluidized state, behaves in many respects like a liquid. This phenomenon allows the complete immersion of heated forms into a fluidized bed of plastics powder for coating and should similarly allow the complete immersion of wet forms.

Fig. 1—Diagram showing apparatus used for fluidized bed particle coating



The equipment used to accomplish fluidization of a particle bed is very simple in design. A fluid bed system consists of two chambers separated by a horizontal fluid diffuse plate. The lower, or downstream, chamber is a high pressure chamber provided with the fluid inlet line. The upper, or upstream, chamber contains the fluid bed. The diffuse plate provides uniform fluid distribution into the upstream chamber. Construction material for the system must be rigid and impermeable to the fluid. Specification of particle size and density, fixed-bed height and porosity, and fluid medium, sets minimum values on the operational variables in accordance with the theory of solid fluidization.

Procedure

The use of gas-solid fluidization was considered in devising an improved method for the application of solid, granular particles to a wet form. The unit designed and built for fluidization of a particle bed is shown in Fig. 1.

Conventional design was adhered to in the provision for two vertical chambers. The cross-sectional area of each was specified as a rectangle of invariant dimensions. This deviation from conventional fluid bed design was made in order to permit the downstream chamber to act as a structural base for the unit in addition to its role as a gas reservoir, and to achieve a maximum working volume in the upstream chamber for fixed overall dimensions. Dimensions of the upper chamber were selected so as to provide for the immersion of large pattern assemblies, ease of the immersion operation, and the existence of a volume above the bed to ensure solid streamer recovery (ejection of solid particle clusters from bed surface occurs during fluidization) during operation.

The height of the downstream chamber is 20 in.; the height dimension of the entire unit is 44 in. The unit measures 18 in. by 18 in. in cross-section. Construction material for the system is 0·037 in. sheet metal. Although the metal does not satisfy one of the aforementioned criteria, rigidity, its low cost and ease of fabrication account for its use. Rigidity of the vertical walls is maintained by the use of strategically-placed tie rods.

Selection of a suitable fluid diffuse plate was made on the basis of availability of certain foundry materials. Plates of resin-bonded sand, of thicknesses ¼ in., ½ in. and 1 in., and a 1¼ in. plate of porous refractory brick were formed and evaluated separately. Plate support was provided by an iron grate set on a ¾ in. lip projecting horizontally from the top of the downstream chamber. All plates were sealed into place using ordinary brick mortar.

The relative cost, availability, and inertness of compressed air made it an obvious choice for the fluidizing medium.

Alumina particles of average diameters 0·0138 in. and 0·0062 in. and silica particles of 0·0117 in. average diameter were utilized in particle beds of varying fixed-bed height and constant fixed-bed porosity. Each of these three particles is currently used in mould production at Watertown Arsenal.

Results

Complete fluidization of all particle beds was accomplished by use of the porous refractory brick diffuse plate and a controlled fluid input from a 90 lb/in^2 gauge source. The porosity of the resin-bonded sand plates proved to be insufficient for the air flow necessary under the given conditions. Long heating periods at 450°F. failed to increase the porosity measurably.

Particle coatings of each of the three size particles were applied to all available size and shape variations of pre-wetted patterns by immersion into the fluidized bed. In comparison with the former method, the fluidization technique required but a few seconds of labour, involved a simple movement of the form, coated all forms rapidly and evenly, eliminated the possibility of pattern damage by a particle stream, reduced the amount of lost solids, and eliminated atmospheric pollution by dust. In addition, the process equipment is far less costly than any mechanical unit used for continuous coating. Maintenance of the system merely involves a periodic screening of the particle bed to remove impurities accumulated during operation.

Fluidized systems for particle coating are now operating most successfully at the Watertown Arsenal in the production of standard investment casting moulds and also in the production of new ceramic type precision moulds.

References

[1] J. A. Neumann and F. J. Bockhoff; *Product Eng.*, 1957, January, **28**, (1), 140.

[2] R. L. Checkel; *Modern Plastics*, 1958, October, **36**, (2), 125.

New Plant & Equipment

Oven Curing

A NEW series of recirculating ovens with three forms of heater, and 36 standard sizes, has been introduced by G. and R. Gilbert (Industrial) Ltd., Hackbridge Road, Hackbridge, Wallington, Surrey, to supplement their range of standard ovens for stoving, drying, curing, pre-heating, baking, etc.

The primary advantages of recirculating ovens over other types of batch oven are floor level loading, without recourse to pits or ramps, more uniform temperature conditions, the ability to handle more densely packed loads without creating cold spots, and in many cases to cut process times by reason of faster heat transfer and quicker removal of solvents and vapours from the working space.

Directly fired ovens have a neat gas burner firing into a stainless steel combustion cylinder mounted in an insulated steel heater body, recirculating air being drawn through the body of the heater mixing with the products of combustion before passing to the oven over a special type of hot gas fan. Full thermostatic and safety controls are supplied with these ovens as standard equipment.

Electrically heated ovens have a series of metal sheathed magnesium oxide or steatite insulated heater elements fitted into an insulated steel casing. Deflectors are used to provide increased surface area for heat transfer. Elements are normally connected back to burners fitted in a closed casing formed on top of the heater. The standard series ovens do not have flameproof equipment, although this can be supplied in some cases. Ovens are provided with thermostatic control and H.R.C. fused isolators.

The sectional construction used enables installation in buildings with restricted access and allows of widths of 5 ft., 6 ft. and 7 ft., heights of 6 ft. 6 in. and 7 ft. 6 in. to be built up in 4 ft., 5 ft., 6 ft., 8 ft., 10 ft. and 12 ft. depths. Larger ovens and steam or oil-fired units employing basically standard sections can be built up to order.

Spark Erosion

EMBODYING the Languepin design feature of auto-elevation and retraction of the tank containing the dielectric, three spark erosion machines are now being built in this country by Solar Weld Languepin Ltd., Fulledge Works, Burnley, Lancs. The Seleromat A has an erosion head mounted on an articulated arm which can be swung away to give uninterrupted vertical access over the whole area of the worktable.

The Seleromat B is essentially similar to the model A but has its erosion head mounted on co-ordinate slides which permit the accurate location of electrodes over any station of the workpiece area.

The Seleromic is the smallest of the three machines and is a bench-mounted unit. It possesses a number of refinements not usually available in machines of like size.

A complete spark erosion machine installation comprises (i) the machine itself, (ii) the spark generator, which is housed in a separate cabinet and is connected to the erosion head by a screened coaxial cable, and (iii) a filtration unit for removing micro-solids from the dielectric fluid.

The Seleromat A and B machines operate with common spark generators, filtration units and electrode-carrying servoheads.

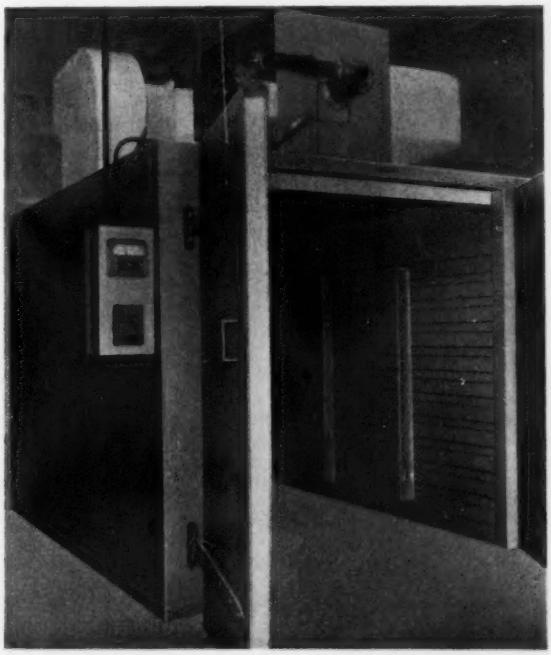
The capacity of the two standard machines, with UE 2500 2M generator and 2·75 in. dia. copper electrode working on a steel specimen heat-treated to ~56 Rockwell C, enables the following results to be obtained: roughing at an erosion rate of 1,000 mm^3/min., a surface finish of 50 microns and a tolerance of 0·004 in. can be achieved; for semi-roughing at 140 mm^3/min., a finish of 18 microns and a 0·003 in. tolerance is possible. For finishing and super-finishing the figures are, respectively, 9 mm^3/min., 5 microns, 0·001 in., and 2 mm^3/min., 2 microns, 0·0003 in.

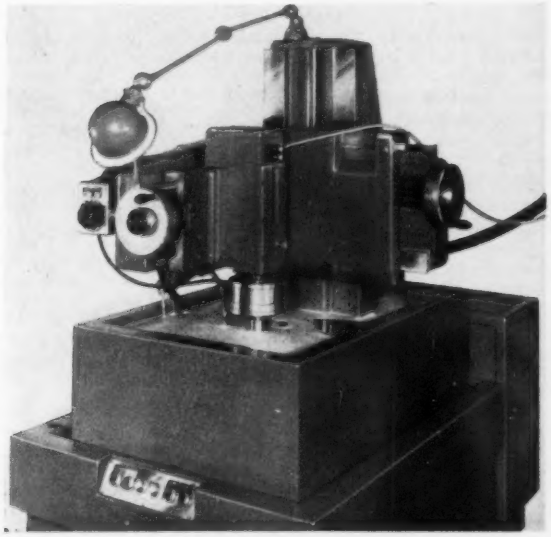
Vibration Analysis

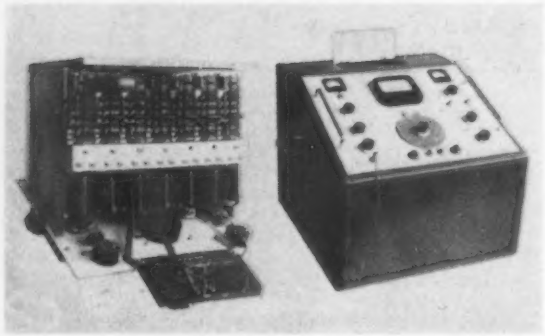
A NEW electronic spectrum analyser capable of analysing waveforms of vibrations, strains and resonances as low in frequency as

Right—Direct gas-fired oven with heater and fan assembly mounted above the oven

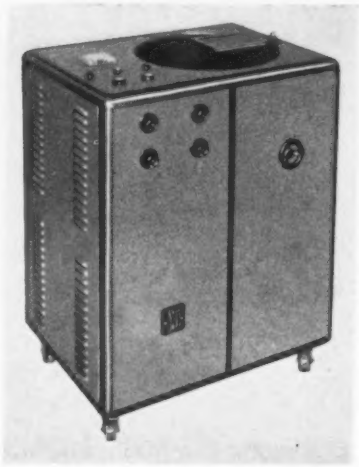
Below—Seleromat B spark erosion machine with dielectric tank fully raised







Left—Electronic spectrum analyser for vibration investigations



Right—The Model C.3 O. P. Hookercaster for small precision castings

one cycle in three seconds, is being produced by Fenlow Electronics Limited, of Weybridge, Surrey.

The equipment has been developed in the first place for use with aircraft structures, but it has research and design study applications in almost every scientific and technological field. Wherever objectionable vibrations may occur, the instrument will lead to a clear understanding of what is happening and enable positive countermeasures to be made, eliminating much of the trial and error techniques which are in use today.

The instrument has a frequency range from one cycle in three seconds, up to over a thousand c.p.s., and the output gives a true indication of the power density in the frequencies under observation. It is fully transistorized and easily transportable. Analogue computer techniques are used, and monitor points enable six operational amplifiers in the instrument to be used for a variety of other purposes. For instance, they may be used to simulate equations for a mechanical system.

It can be supplied with recording equipment and other auxiliaries to suit the particular conditions involved.

Precision Casting

DESIGNED to melt all metals from light alloys to gold and silver through the range of non-ferrous metals up to steel and platinum, the O. P. Hookercaster uses H.F. induction heating. The combination of melting unit with the centrifugal casting unit ensures that the cast is made within seconds of the metal reaching the right temperature and without the need to remove the crucible.

The unit employs a radio frequency generator of a new design with an extremely high efficiency. All functional controls for the operation of the machine are conveniently placed. Through the use of only three push buttons mounted on top of the instrument panel and a lever wheel on the front plate of the machine, it is possible to make a complete melting and casting operation within seconds. Melting times vary with various types and weights of metal charged, but capacity will not exceed 8 oz. of any metal on model C.3.

The material to be melted is placed in a crucible, which is situated in a cradle in the casting head. To melt, the work coil is raised so that it surrounds the lower portion of the crucible. After melting, the work coil is retracted and safety devices ensure that it must be lowered before the centrifugal casting arm is set in motion. An automatic overload system will protect the machine against overloading.

The casting arm in the head of the machine carries the crucible and mould at one end and an adjustable counter balance weight at the other. The arm itself is actuated by a 0·35 h.p. three-phase motor situated to one side of the casting chamber, adjustable for any one of three different speeds. A special electronic brake system enables the operator, by pressing a button, to brake the casting arm rotation either instantaneously or slowly as may be desired. To ensure silent operation, the casting section of the machine is mounted on shock absorbers, and the whole machine is fitted with four heavy, rubber castors for silent and easy movement.

STANDARD SPECIFICATIONS

Galvanized Steel Wire for Armouring Submarine Cables. (*B.S.*1441 : 1961.) *Price* 4*s.* 6*d.*

WHEREAS the old edition of B.S.1441 dealt only with galvanized high tensile steel wire, the new edition covers four classes of galvanized steel round wire in sizes ranging from 0·340 in. to 0·083 in. in diameter for armouring submarine cables.

Classes covered are as follows: mild steel wire, tensile range 24-32 tons/in^2; mild steel wire, tensile range 29-36 tons/in^2; medium tensile steel wire, tensile range 42-52 tons/in^2; and high tensile steel wire in tensile ranges of 60-70 tons/in^2, 70-80 tons/in^2, 80-90 tons/in^2 and 95-110 tons/in^2.

Methods of test, test requirements and tolerances are specified, and details are provided relating to the various sizes for each class and tensile range of wire, selection of test samples, re-tests, galvanizing, packing and identification.

Investment Castings in Metal : Part 2 : High Alloy Steels, Nickel and Cobalt Alloys. (*B.S.*3146 : *Part* 2 : 1961.) *Price* 8*s.* 6*d.*

PREPARED to meet the needs of industry in the rapidly growing field of investment castings, this standard does not specify castings made by shell moulding but only those made by a process which involves the investment of an expendable pattern by refractory slurry. The advantages of investment castings of the type described in this standard are the complexity of the shapes that can be cast and the accurate approach to final form that can be obtained without a large amount of machining which may be difficult. These advantages apply particularly to material which is extremely hard or tough.

Section One covers the general requirements and specifies the process of manufacture, the method of identification of the casting, the procedure for testing both mechanically and by non-destructive methods, and the arrangement necessary for repairing castings.

Section Two covers the specific requirements of 18 different types of castings, many of which are sub-divided into two or three grades. The chemical composition of each type of casting is specified in detail, together with the mechanical properties which are required.

Copies of the above-mentioned standards may be obtained from the British Standards Institution, 2 Park Street, London, W.1.

Industrial News

Home and Overseas

A Postponement

In view of the Lord Mayor of London's official visit to Amsterdam on April 23 next, the **London Metal Exchange** has decided to postpone the opening ceremony of the reconstructed Exchange to Friday, April 28, so that the Lord Mayor may still perform the opening ceremony.

The arrangements for the dinner to be given by the L.M.E. at the Savoy Hotel, London, on April 25, to mark the occasion, remain unchanged. The guest of honour at this dinner will be the Rt. Hon. Iain Macleod, M.P., Secretary of State for the Colonies.

Contracts Secured

From widely separated parts of the Commonwealth, **British Insulated Callender's Cables Limited** have received two interesting contracts, each calling for the supply of oil-filled cable with corrugated seamless aluminium sheath, protected overall with an extruded PVC jacket.

The installations are at Bulimba, near Brisbane, Queensland, and on Vancouver Island, British Columbia. It is understood that in each instance it will be the first installation in Australia and Canada respectively of oil-filled cable with corrugated aluminium sheath designed and manufactured by BICC.

The Dechema

A 16-page brochure, in colour, has recently been distributed by **Deutsche Gessellschaft für chemisches Apparatewesen e.V.** giving information, in English, French and German, of the aims and tasks of the Dechema and the work it has done over the past 35 years of its existence. The objects of the organization are to foster co-operation by chemists and engineers in the field of chemical engineering and chemical technology, and to promote research and education in these fields. Copies of the brochure may be obtained on application to the Dechema, Frankfurt am Main 7. Postfach 7746.

Kaldo Furnace Plant

An order for the design, supply and installation of oxygen-blown Kaldo furnace plant for the Etruria works of Shelton Iron and Steel Ltd., at Stoke-on-Trent, has been received by **Davy and United Engineering Company Ltd.** The contract is valued at approximately £1 million.

Davy and United will also be responsible for the overall engineering of the whole of this project, which, it is said, will comprise the first complete steel melting shop in the U.K. to use only Kaldo furnaces.

Aluminium and Refrigeration

At the International Refrigeration and Air-Conditioning Exhibition, to be held at Earls Court, London, next month, the feature of the stand occupied by **Alcan Industries Limited** will be the wide and varied range of uses of aluminium in the fields of refrigeration and air conditioning.

The photograph on this page is of an evaporator plate for the G.E.C. Coldair refrigerator, made from a panel of Noralduct roll-welded plate. Depicted in the photograph is the single concentric inlet/outlet system with internal capillary, to which the Noralduct evaporator ideally lends itself.

One of the newest commodities to be shown is "Noraltrace", also produced by extrusion. It takes the form of a double-holed tube, the smaller hole providing the trace line, which can be used for steam, refrigerant or hot-gas defrost. It is offered in three sizes, and the display will include flange fittings and two methods of jointing.

L.M.E. Warehouse List

Notice has been given by the London Metal Exchange that the following warehouses have been admitted to the official list of wharves and warehouses for the storage of metals:—Ouseburn warehouse —R. Steenberg and Sons Ltd., Ouseburn warehouses, Quayside, Newcastle upon Tyne, 1, and Royal Edward warehouses B, C and D—Port of Bristol Authority, Queen Square, Bristol, 1.

Canning's "20 Club"

With a total membership of 316 active and retired members, the "20 Club" of **W. Canning and Co. Ltd.** reflects the ability of this company to retain the services of a high proportion of its employees. Employees are eligible for membership of the club only after 20 years' service with the firm, and at the annual dinner, held at the head office on Thursday, March 9, 262 members were present. Noteworthy among these were seven members who have served the company for more than 50 years. They are Sir Ernest R. Canning (66 years), Mr. W. H. Griffin (56 years), Mr. W. Brealey (55 years), Mr. J. Robinson (55 years), Mr. A. Lynall (53 years), Mrs. J. Davis (51 years), and Mr. J. H. Clayton (51 years), and of these Mr. Griffin and Mr. Clayton are still active members of the company. The total number of members of the "20 Club" (active and retired from the company), as at December 31, 1960, is 316, and 18 employees have completed 20 years' service during 1960. There are 57 pensioner members, 36 of whom attended the dinner.

Welcoming the 18 new members who have become eligible for membership during 1960, Mr. F. H. Ewens referred to the full order books the company had enjoyed throughout 1960, with an increase of 20 per cent in export business and equipment supplied to 54 countries.

Long service awards were presented by Sir Ernest Canning to the 18 new members.

Standards Engineers

It is announced that the seventh annual conference of engineers and others concerned with the application of standards will be held this year on May 9 and 10, and will be opened by the Rt. Hon. Viscount Hailsham, Lord President of the Council and Minister for Science.

The first day of the conference will consist of plenary sessions at the Connaught Rooms, London, and the second day's programme will be held at British Standards House, in Park Street, London, W.1.

West German Production

According to statistics recently issued by the Federal Bureau of Statistics, West German pig aluminium production in January this year totalled 14,131 tons, as compared with 14,473 tons in December last.

The production of aluminium alloys amounted to 10,404 tons (provisional), against 10,414 tons in December, and production of aluminium semi-manufactures and aluminium alloy semi-manufactures 20,951 tons (provisional), against 20,942 in December.

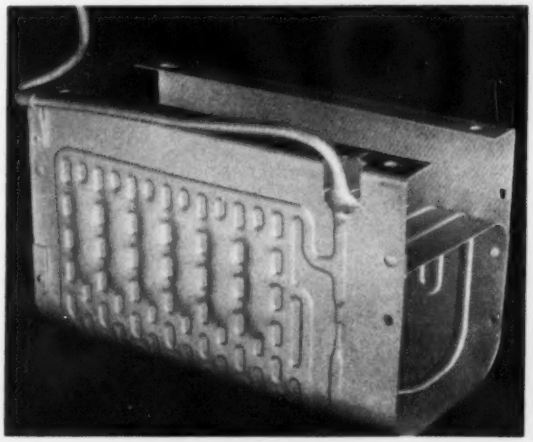
U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week fell 29 tons to 9,990 tons, comprising London 4,291, Liverpool 3,707 and Hull 1,992 tons.

Copper stocks rose 125 tons to 15,515 tons, distributed as follows: London 1,125, Liverpool 12,290, Birmingham 100, Manchester 1,950 and Hull 50 tons.

Lead duty free stocks fell 26 tons to 6,554 tons, while in bond stocks were unchanged at 3,867 tons. All supplies were in London.

Zinc duty free stocks fell 335 tons to



This evaporator plate for the G.E.C. Coldair refrigerator is made from a panel of Noralduct roll-welded plate produced by Alcan Industries Limited. The photograph shows the single concentric inlet/outlet system with internal capillary

2,739 tons, while in bond stocks fell 25 tons to 300 tons, comprising London duty free 627 tons and in bond 300 tons; Liverpool duty free 2,092 tons and in bond nil tons; Glasgow duty free 20 tons and in bond nil tons.

Bronze and Brass Founders

Midland area members of the **Association of Bronze and Brass Founders** are to hold a meeting on Wednesday March 29 next, at the Victoria Hotel, Wolverhampton. The morning session will commence at 11.30 a.m., followed by luncheon at 1 p.m. The afternoon session will commence at 2 p.m.

Meeting at Banbury

At the Crown Hotel, Banbury, Oxon, on Tuesday, March 28, at 4 p.m., the Corrosion Group of the **Society of Chemical Industry** will hold a meeting at which two lectures will be presented and discussed.

Dr. H. P. Godard will speak on "The Resistance of Aluminium to Supply Waters", and Dr. E. A. G. Groom and Mr. D. Hastings will speak on "Behaviour of Aluminium in Modern Power Station Condensate Water".

Post-graduate Course

A post-graduate course in welding technology has been set up by the Ministry of Education in response to the representations of the Institute of Welding and the British Welding Research Association. This one-year course is to be held at the College of Aeronautics, Cranfield, and will consist of three terms. The autumn term will commence on October 9 this year and conclude on December 15. The spring term will be from January 15 to March 30, 1962, and the summer term from April 30 to July 6, 1962.

A prospectus and forms of application may be obtained on application to the Warden, The College of Aeronautics, Cranfield, Bletchley, Bucks.

Copper Ore Production

According to statistics from New Delhi, India mined 448,000 tons of copper ore in 1960. The entire production was reported to be from the Singhbhum district of Bihar State. This represented an increase of about 11 per cent over the 1959 output. Production of copper metal in 1960 was 8,910 tons.

Lead in U.S.A.

Production of 23,000 tons of recoverable lead in January 1961 was reported in the United States, according to the Bureau of Mines, United States Department of the Interior. The January output represented an increase of 19 per cent over the preceding month's output and was the largest monthly mine output since April 1960.

Total output of lead from mines in states east of the Mississippi was 672 tons, a decline of 10 per cent from the preceding month's total, while a reported production of 9,100 tons from mines of the Southeast Missouri lead belt represented a decline of 3 per cent from December.

Production from mines in the Western States of 13,000 tons represented an increase of 47 per cent over the December output. The larger output was attributed to increases by California, Idaho, Montana, and Utah.

By far the largest share of the increased production was attributed to Idaho, which reported an output of 6,370 tons, an increase of 177 per cent over the December 1960 figure. The return to normal production at Bunker Hill in the Coeur d'Alene region, after settlement of the strike, accounted for most of the increase.

At the Canning "20 Club" dinner last week. (See note on page 213). (Left to right, standing)—Mr. J. H. Clayton, Mr. A. Lynall, Mr. W. Brealey, Mr. J. Robinson, (sitting)—Sir Ernest Canning, Mrs. J. Davis and Mr. W. H. Griffin

Agents Appointed

An announcement from The United Insulator Division of the **Telegraph Condenser Company Limited** states that they have appointed **Celtic (Leicester) Distributors Limited,** of 89 London Road, Leicester, to be their East Midlands agents for Unikote ceramic coatings. The area they will cover includes the counties of Leicester, Derby, Nottingham, Lincoln, Northants, Norfolk, Suffolk and Cambridge.

A Works Visit

Some 60 members of the Newcastle branch of the **Institute of British Foundrymen** visited the new roll foundry and roll machine shop of Armstrong Whitworth (Metal Industries) Ltd., Close Works, Gateshead-on-Tyne, 8, on Saturday of last week. They were told by Mr. J. L. Smith, foundry manager, that the company had spent £500,000 on enlarging roll-production facilities, and now hoped to increase output to 15,000 tons a year.

The new foundry where rolls of up to 50 tons can be cast, was opened last month by Mr. Reginald Maudling, President of the Board of Trade. It is 220 ft. long, 55 ft. wide, and carries a 75-ton overhead travelling crane at a height of more than 40 ft. Melting equipment comprises four air furnaces with capacities varying from 15-25 tons, and a 3-ton electric furnace for special alloy additions. The range of modern plant installed in the new machine shop is being augmented by a Herkules high-precision grinding machine currently being installed in another part of the works.

This year's President of the branch is Mr. J. C. Robinson, assistant foundry manager of the company. The size of the party inspecting Close Works was the largest for a Newcastle branch visit for several years.

Evening Lectures

A series of six evening lectures on "Organization and Methods" is to be held at Regent House, St. Philip's Place, Birmingham, 3, commencing on Tuesday, April 4 next. This series has been organized by the Birmingham branch of the **Institute of Office Management,** and is designed to give senior executives responsible for office management an introduction to the techniques of organization and methods. The lectures will commence at 6.30 p.m. each Tuesday, and refreshments will be provided at 6 p.m. The fee for the whole series is £3 3s. 0d. for members of the Institute and £4 4s. 0d. for non-members. Full details and applications for tickets may be obtained from Mr. P. F. Thomas, South Staffordshire Waterworks Co., 50 Sheepcote Street, Birmingham, 15.

Pressure Die-casting

Trials of the Triulzi 2,200-ton pressure die-casting machine are being planned for next month, when the 45 lb. Volga cylinder block will be put into production for a whole week, working day and night. Although the exact date of the trials is not yet fixed, die-casting engineers anxious to see this machine at work in Milan may obtain further details from **Alexander Cardew Limited,** London, S.W.1.

It is also understood that at the end of March a smaller (25 lb.) aluminium cylinder block for the Skoda Company will be tried out on a 1,500-ton Triulzi machine.

Spanish Lead Prices

It is reported from Madrid that the price at which smelters may purchase Spanish lead ore will be calculated on the basis of the daily international quotation for lead registered on the London Metal Exchange. The new pricing formula was effective from January 1, 1961. The previous pricing formula did not take into consideration the international price of lead.

The price of a metric ton of lead ore, 70 per cent lead and little or no silver content, calculated under the new formula on the basis of £65 a long ton, is 5,388 pesetas, compared with 9,802 pesetas under the old formula.

Informed sources said that the new pricing formula confirmed that the Mining Assistance and Regulation Fund had ceased operations. This Fund served to pay an assistance premium of 1,500 pesetas per ton to home lead mining, and to subsidize lead exports, the sources said. The Fund had been financed by a levy of 4,475 pesetas per ton imposed on lead metal sold in the home market.

These sources believed that the new pricing formula would force marginal lead ore mines to close down. On the other hand, price reductions (with effect from January 1, 1961) of lead metal sold in the home market were officially announced last week following the temporary lifting of the foundry and sale taxes. The reductions, aimed at stimulating home consumption, amounted to 1,255·6 pesetas per ton for lead ingots and 1,351 pesetas per ton for tubes, sheets, etc.

Soviet Non-Ferrous Metals

News from Moscow is that the annual rate of increase of non-ferrous metal production in the Soviet Union during the first two years of the Seven Year Plan (1960 and 1961) was substantially above the planned target, according to the *Economic Gazette*.

A great deal has been done to expand the capacity of existing enterprises. Nevertheless, in many cases this expansion was taking place at the price of excessive expenditure. The main task, the journal said, is "increased output and enhanced capacity with smaller capital investments than scheduled by the plan". There was much scope for such savings in ore enrichment plants, but in many cases the metal content in ore concentrates had failed to increase. This applied in particular to copper, aluminium and nickel concentrates.

An A.G.M.

Members of the **Non-Ferrous Club** are notified that the annual general meeting of the Club will be held on Thursday next, March 23, at the Queen's Hotel, Birmingham, at 7 p.m. The meeting will be preceded by dinner.

Metallic Corrosion

Readers are reminded that the first International Congress on Metallic Corrosion is to be held in London from April 10 to 15 next. The headquarters of the Congress will be at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, London, S.W.7.

The Congress will be officially opened at 2.30 p.m. on Monday, April 10, by Sir Harry Melville, K.C.B., D.Sc., F.R.I.C., F.R.S., followed by the first scientific session. A series of works visits have been arranged during the period of the Congress.

Aluminium in Yugoslavia

In a review of the prospects of developing the aluminium industry in the country, the Federal Chamber of Foreign Trade in Yugoslavia states that the country has a reserve of about 160 million tons of tested bauxite, which represents about 7·3 per cent of the world reserve.

The insufficient excavation work in bauxite so far is stressed in the survey, and it can reasonably be expected that the further explorations of bauxite areas will reveal new deposits. The results of excavation work so far show that the Montenegreen deposits are the largest. The quality of bauxite in this region varies, but on an average it is estimated to contain about 56-60 per cent Al_2O_3 and about 4 per cent S_iO_2. The Hercegovinean region has also considerable ore deposits.

Australian Uranium

It is understood that the Australian Government will extend to June, 1968, current taxation concessions for the mining and treatment of uranium ore. The Minister of National Development said that the Government had made its decision after a full review of the uranium industry in Australia and of the problems likely to arise from the reduction in demand which was expected after expiration of existing contracts.

Grant to D.S.I.R.

In the Civil Estimates published this week it is noted that an increase of £2·5 million has been made in the Government's grant to the Department of Scientific and Industrial Research for the coming financial year. The total figure for the year is shown at £17·3 million, as against £14·8 million in the previous year.

It would appear that the main increases are in the grants for investigation and research in the scientific field, as well as in the post-graduate training awards. Grants to universities and other bodies are increased by over £1 million.

Flame Controllers

A new range of flame controllers for safely igniting and monitoring multi-burner installations in industrial concerns has recently been developed by **Ether Limited.** These units are of the very latest design — fully transistorized, with plug-in circuitry and A.C. coupled amplifier—for use with gas-fired and oil-fired burners, or burners working on a combination of both fuels. Moreover, they discriminate between flame and flame-radiation, and are said to be unaffected by the latter. Series 704 flame controllers can be supplied for controlling up to six flames at once.

Tin Export Quota

AT the meeting of the International Tin Council, held in London last week, it was decided not to fix a total permissible export amount for the second quarter of this year after reviewing the statistical position of the metal. Representatives were present from Austria, Australia, Belgium, Bolivia, Canada, Republic of the Congo (Leopoldville), Denmark, France, India, Indonesia, Israel, Italy, Federation of Malaya, Netherlands, Federation of Nigeria, Ruanda - Urundi, Thailand, Turkey and the United Kingdom. In a press communique, the council said the amount of tin held in the buffer stock on September 30 last year was 10,030 tons.

The next meeting of the council will be held here during April or May, the exact date to be fixed later, the communique said.

The meeting was preceded by a meeting on March 7 and 8 of the interim committee for the Second International Tin Council, at which Japan and Mexico were represented. This interim committee considered matters of detail regarding the setting up of the Second International Council, it added.

The Congo Administration has written to the International Tin Council indicating it wishes to ratify the new agreement of the I.T.C., which comes into force on July 1 this year. Mr. Georges Peter, chairman of the I.T.C., announcing this at a press conference after the I.T.C. meeting, warmly welcomed this action. The difficulties of the Congo had not been as big as expected, he said. Australia had already ratified the agreement, and the ratifications of other member countries were known to be on their way.

Questioned about the attitude of the Soviet Union and the United States to the new agreement, Mr. Peter said that although both countries had sent observers to the tin agreement discussions in New York last year, nothing more had been heard from them. West Germany had also shown great interest in the New York discussions, but she had not, in fact, joined the agreement, and it was not known if she was interested in joining the new one.

On the transition from the old to the new agreement, Mr. Peter said the old buffer stock would be liquidated on paper and a part returned to producers—about 20 per cent. Contributions to the new stock would, in fact, be made by the transfer of stock from the first agreement and cash on the basis of the floor price. The second buffer stock could become larger now that the I.T.C. had the power to borrow funds from banks, he added. Mr. Peter added that there was no production of tin in the Congo at the present time. Some exports were being made from stocks, but quantities were not known.

Forthcoming Meetings

March 20—Institute of British Foundrymen. East Anglian Section. Lecture Hall, Public Library, Ipswich. "Accuracy in Moulds and Cores." W. B. Parkes. 7.30 p.m.

March 20—Institute of Metal Finishing. London Branch. Northampton College of Technology, St. John Street, London, E.C.1. "Zinc Plating from the Pyrophosphate Bath." U. F. Marx and D. Povey. 6.15 p.m.

March 21—Institute of Metal Finishing. South-West Branch. Royal Hotel, Bristol. "Rectifiers in the Metal Finishing Industry." D. Ashby. 7.30 p.m.

March 21—Institute of Metals. South Wales Local Section. Metallurgy Department, University College, Singleton Park, Swansea. Annual General Meeting, followed by Chairman's Address. 6.30 p.m.

March 21-23—Institute of Metals. Spring Meeting. Opening on first day at Church House, Great Smith Street, London, S.W.1. 10 a.m.

March 21 — West of England Metallurgical Society. College of Technology, Ashley Down, Bristol. "Physical Methods of Analysis." K. M. Bills. 7.30 p.m.

March 22 — Birmingham Metallurgical Society. Pavilion Suite, Edgbaston. Annual Dinner and Dance. 7 p.m.

March 23 — Southampton Metallurgical Society. Southampton University. Annual General Meeting. "Metallurgy of Ferrous Welding." Dr. R. G. Baker. 7.15 p.m.

March 24—Institute of Metal Finishing. Sheffield and North-East Branch. Grand Hotel, Sheffield. "Duplex Nickel and Crack-free Chromium for Improved Corrosion Resistance." T. E. Such. 7 p.m.

Metal Market News

ADVANCE figures relating to copper and zinc have been issued by the British Bureau of Non-Ferrous Metal Statistics, which show, as might be expected, that January made a better showing than December. Consumption of copper, primary and secondary, in January was 59,155 tons against 56,279 tons in the previous month, while stocks appreciated sharply from 114,452 tons at the end of the year to 122,694 tons at January 31. In zinc, the stock of metal increased from 59,397 tons at December 31 to 63,152 tons a month later, while consumption showed little change at 28,737 tons, being about 250 tons up on December. Lead usage showed an increase of 1,000 tons at 31,145, stocks being 3,677 tons up at 68,856 tons. In tin, there was a satisfactory increase in consumption from 1,588 tons to 1,803 tons, while stocks showed a small increase at 11,865 tons. These figures must be considered as satisfactory, for they at least indicate that a good start has been made to this year. Indeed, if one considers the Copper Institute statistics for January it is impossible to find much wrong with the situation in copper, although it is true that production is somewhat in excess of consumption. Last week saw an increase of 315 tons in the stocks of standard copper in L.M.E. warehouses, making the total 15,390 tons. Business with consumers was not over bright, and there certainly was not much to encourage them to buy, for the market showed a somewhat drooping tendency in spite of news from Chile that a general strike had broken out in the docks there.

Tin was the metal that put up the best show last week, for the close at £809 for cash and £812 for three months showed a gain of £6 in both positions. The turnover was 860 tons, and it is encouraging that during the past few weeks business in the ring has increased. On Friday, it was reported that the Tin Council, at its meeting held last week, decided to make no change for the second quarter in exports, which, therefore, remain on an unrestricted basis. It will be remembered that control of exports was lifted on October 1 last, and judging by the way the statistical position has developed, this was a wise decision to make. It is now confidently expected that an improvement in tinplate activity is at hand and, on the whole, there is a good deal of optimism about the immediate future of the metal. Lead and zinc both made a good showing last week. Stocks of lead in Metal Exchange warehouses were sharply down, by 583 tons to 10,447 tons, and the market improved by £1 12s. 6d. for cash to £66, while three months was £2 better at £67 5s. 0d. The turnover was 8,125 tons. Stocks of zinc dropped by 228 tons to 3,399 tons, and both positions gained 30s., to £85 10s. 0d. for cash and £84 three months. Some 5,800 tons changed hands.

On the standard copper market, the turnover was 8,350 tons. Price movements were within fairly narrow limits, and the close, at £224 5s. 0d. cash and £225 15s. 0d. three months, registered losses of 30s. and 25s. respectively. The increasing stocks are helping the contango. Opinion about the dock strike in Chile seemed to be rather mixed, but it was not thought that the trouble would be of long duration. Bear covering operations on the market appear to have been completed, for the time being anyway, and there is not enough optimism about the immediate future to encourage bulls to intervene in a decisive manner.

Birmingham

Apart from strikes — fortunately of short duration—the improvement in the motor trade has been maintained, and the employment situation continues to improve in the Midland area. The metal trades are well employed on the whole. Building work is active, and there is a good demand for castings and pressings, as well as for copper tubing for heating purposes. Many firms are maintaining and extending their export trade despite strong competition. The market for household goods is brisk. Firms engaged in heavy electrical engineering are well situated for orders over the next few months.

The Midland area is still leading the country as far as the output of iron castings is concerned. Much of the work is being done for engineering firms and for the motor trade. Steel output is below the peak levels reached last autumn. Stocks are heavier, but now that the car trade is on the road to recovery it is expected that these will again be reduced. More steel sheets are likely to be used in the next quarter, but there will be no difficulty in meeting a rising demand. Steelmakers are benefiting from the boom in the building industry, and the works making joists, sections and reinforcing bars are well placed for business.

New York

Copper futures were steady in quiet dealings at the week-end. In physical copper, dealers indicated quiet conditions, while custom smelters noted that interest was lighter today. Producers' sales continued moderate to fair. Tin was steady but quiet. Lead and zinc were quiet. Lead futures were more active. Buying of the March 1962 contract was reported. In the closing stage, tin was barely steady and quiet. The scrap copper price was unchanged. Offerings were fair.

No change whatsoever in the pattern on the platinum market was reported during the week ended on March 8. Primary sellers held to their officially advertised asking levels of $82/$85 per troy ounce, depending on quantity, while outside market dealers continued to offer adequate supplies of the metal at $80 or even, in some instances, up to half-dollar cheaper. No gain in the pace of consumption or demand was noticeable. The New York Mercantile Exchange futures market remained inactive.

The first commercial production of strain hardening aluminium tapered pole products has been announced by The Union Metal Manufacturing Company of Canton, Ohio. Officials of Union Metal said their unique fabricating process will make available a wide variety of designs. Applications for the new aluminium pole products include street, highway and off-highway lighting poles; traffic signal poles, and overhead sign supports. New applications are expected to be developed for floodlighting poles, antenna masts, and other structural uses.

Zurich

Turnover in February on the Swiss non-ferrous metals market was more or less the same as in the previous month. According to trade circles, sales to large industrial users were substantial, while demand from medium sized and small engineering works was on the dull side. A seasonal increase characterized buying by the building industry.

Non-ferrous metal users were cautious since they did not believe that the rises registered of late on the London Metal Exchange would be of a lasting nature. Thus, demand was limited to current requirements and stocks tended to be reduced.

Yugoslavia

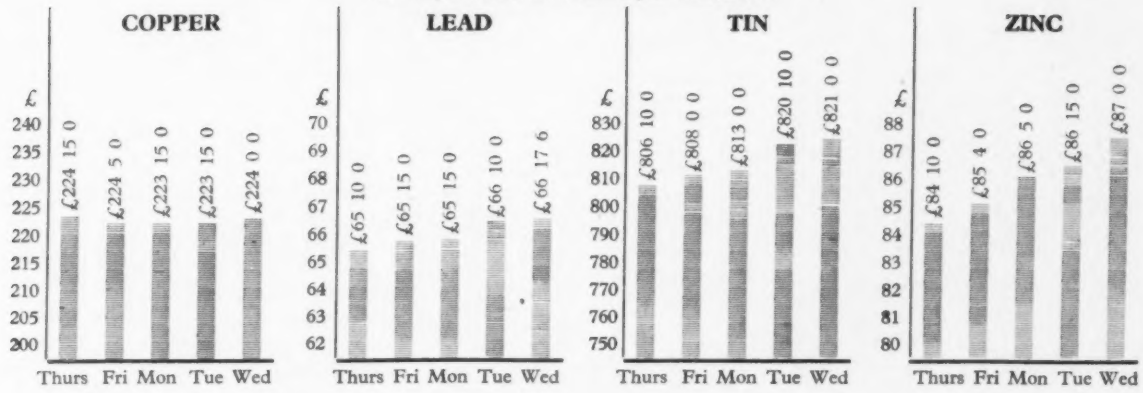
The Yugoslav Government has published a list of goods which domestic enterprises may import from abroad under four new import categories introduced by recent new regulations on foreign trade and foreign exchange. The four categories are (i) free imports, (ii) imports on the basis of a liberal permit, (iii) imports of goods for which import quotas have been set, (iv) imports of goods on the basis of a restrictive permit.

Included in the first category are wolfram concentrate, manganese ore, magnesium, wolfram and molybdenum wire and tetraethyl lead; in the second category, copper and copper alloy waste and scrap; in the third category, aluminium, copper (electrolytic and other types), nickel, chromium ore, tin and tin alloys.

Non-Ferrous Metal Prices

London Metal Exchange

Thursday 9 March to Wednesday 15 March 1961



Primary Metals

All prices quoted are those available at 2 p.m. 15/3/61

		£	s.	d.
Aluminium Ingots	ton	186	0	0
Antimony 99·6%	„	217	10	0
Antimony Metal 99%	„	210	0	0
Antimony Oxide Commercial	„	194	10	0
Antimony White Oxide	„	196	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		11	0
Calcium	„	2	0	0
Cerium 99%	„	15	0	0
Chromium	„		6	11
Cobalt	„		12	0
Columbite	per unit		8	10	0
Copper H.C. Electro	ton	224	0	0
Fire Refined 99·70%	„	223	0	0
Fire Refined 99·50%	„	222	0	0

		£	s.	d.
Copper Sulphate	ton	77	0	0
Germanium	grm.		—	
Gold	oz.	12	10	7
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	66	17	6
Magnesium Ingots	lb.			
99·8%	„		2	2½
99·9+%	„		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		5	6
Alloy Ingot, AZ91X		1	11½-2	1½
Manganese Metal	ton	280	0	0
Mercury	flask	69	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.	20	0	0
Osmiridium	„		—	

		£	s.	d.
Palladium	oz.	9	0	0
Platinum	„	30	5	0
Rhodium	„	46	0	0
Ruthenium	„	16	0	0
Selenium	lb.	2	6	6
Silicon 98%	ton	122	0	0
Silver Spot Bars	oz.		6	7⅜
Tellurium Sticks	lb.	2	0	0
Tin	ton	821	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	85	14	4½
Dust 95/97%	„	125	0	0
Dust 98/99%	„	131	0	0
Granulated 99+%	„	110	14	4½
Granulated 99·99+%	„	126	15	0

**Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg≏£/ton		**Canada** c/lb≏£/ton		**France** fr/kg≏£/ton		**Italy** lire/kg≏£/ton		**Switzerland** fr/kg≏£/ton		**United States** c/lb≏£/ton	
Aluminium			26.00	210 12	2.43	179 11	370	216 1	2.50	210 5	26.00	207 4
Antimony 99.0					2.30	170 0	500	292 0			29.00	231 2
Cadmium					15.75	1,069 0					150.00	1,195 10
Copper												
Crude												
Wire bars 99.9							435	254 0				
Electrolytic	31.75	232 1	27.50	222 15	3.19	235 14			2.75	231 5	29.00	231 6
Lead			10.00	81 0	.94	69 9	163	96 3	.78	65 11	11.00	87 13
Magnesium												
Nickel			70.00	567 0	9.00	665 2	1,170	683 5	7.50	630 15	74.00	589 15
Tin	111.50	814 19			11.33	837 5	1,500	876 0	9.65	811 11	102.00	812 18
Zinc												
Prime western			12.00	97 4 0								
High grade 99.95			12.60	102 1 0								
High grade 99.99			13.00	105 6 0					1.10	92 10		
Thermic					1.20	88 13						
Electrolytic					1.28	94 13	191	111 10			13.00	104 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 15/3/61

Aluminium Alloy (Virgin)	£	s.	d.
B.S. 1490 L.M.5 .... ton	210	0	0
B.S. 1490 L.M.6 .... „	202	0	0
B.S. 1490 L.M.7 .... „	216	0	0
B.S. 1490 L.M.8 .... „	203	0	0
B.S. 1490 L.M.9 .... „	203	0	0
B.S. 1490 L.M.10.... „	221	0	0
B.S. 1490 L.M.11.... „	215	0	0
B.S. 1490 L.M.12.... „	223	0	0
B.S. 1490 L.M.13.... „	216	0	0
B.S. 1490 L.M.14.... „	224	0	0
B.S. 1490 L.M.15.... „	210	0	0
B.S. 1490 L.M.16.... „	206	0	0
B.S. 1490 L.M.18.... „	203	0	0
B.S. 1490 L.M.22.... „	210	0	0
Aluminium Alloys (Secondary)			
B.S. 1490 L.M.1 .... ton	171	0	0
B.S. 1490 L.M.2 .... „	174	0	0
B.S. 1490 L.M.4 .... „	180	0	0
B.S. 1490 L.M.6 .... „	181	0	0
***Aluminium Bronze**			
BSS 1400 AB.1..... ton	244	0	0
BSS 1400 AB.2..... „	252	0	0

*Brass	£	s.	d.
BSS 1400-B3 65/35 .. ton	175	0	0
BSS 249 ..... „		—	
BSS 1400-B6 85/15 .. „	223	0	0
***Gunmetal**			
R.C.H. 3/4% ton .... „		—	
(85/5/5/5) LG2 ..... „	218	0	0
(86/7/5/2) LG3 ..... „	228	0	0
(88/10/2/1) ..... „	282	0	0
(88/10/2/½) ..... „	292	0	0
***Manganese Bronze**			
BSS 1400 HTB1..... „	194	0	0
BSS 1400 HTB2..... „	212	0	0
BSS 1400 HTB3..... „	230	0	0
Nickel Silver			
Casting Quality 12% „	235	0	0
„ „ 16% „	250	0	0
„ „ 18% „	290	0	0
***Phosphor Bronze**			
B.S.1400P.B.1.(A.I.D. released) ..... „	309	0	0
B.S. 1400 L.P.B.1 „	240	0	0

**Average prices for the last week-end.*

Phosphor Copper	£	s.	d.
10% ..... ton	258	0	0
15% ..... „	261	10	0
Phosphor Tin			
5% ..... „	886	0	0
Silicon Bronze			
BSS 1400-SB1 ..... „	284	0	0
Solder, soft, BSS 219			
Grade C Tinmans ... „	376	10	0
Grade D Plumbers .. „	301	0	0
Grade M ..... „	414	0	0
Solder, Brazing, BSS 1845			
Type B (Granulated) lb.		—	
Type 9 „ „		—	
Zinc Alloys			
BSS 1004 Alloy A .. ton	120	5	0
BSS 1004 Alloy B.... „	124	5	0
Sodium-Zinc ..... lb.		2	7½

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium			
Sheet 10 S.W.G. lb.	2	10½	
Sheet 18 S.W.G. „	3	0½	
Sheet 24 S.W.G. „	3	3½	
Strip 10 S.W.G. „	2	10½	
Strip 18 S.W.G. „	2	11½	
Strip 24 S.W.G. „	3	1	
Circles 22 S.W.G. „	3	4½	
Circles 18 S.W.G. „	3	3½	
Circles 12 S.W.G. „	3	2½	
Plate as rolled ..... „	2	10	
Sections ..... „	3	4	
Wire 10 S.W.G. .... „	3	1½	
Tubes 1 in o.d. 16 S.W.G. ..... „	4	4	
Aluminium Alloys			
BS1470. HS19W.			
Sheet 10 S.W.G. „	3	3	
Sheet 18 S.W.G. „	3	5½	
Sheet 24 S.W.G. „	4	1	
Strip 10 S.W.G. „	3	3	
Strip 18 S.W.G. „	3	4½	
Strip 24 S.W.G. „	4	0½	
BS1477. HP30M.			
Plate as rolled ..... „	3	1	
BS1470. HC15WP.			
Sheet 10 S.W.G. „	4	3	
Sheet 18 S.W.G. „	4	8½	
Sheet 24 S.W.G. „	5	8½	
Strip 10 S.W.G. „	4	4	
Strip 18 S.W.G. „	4	8½	
Strip 24 S.W.G. „	5	4½	
BS1477. HPC15WP.			
Plate heat treated ... „	3	10½	
BS1475. HG19W.			
Wire 10 S.W.G. „	4	2	
BS1471. HT19WP.			
Tubes 1 in. o.d. 16 S.W.G. ..... „	5	5	
BS1476. HE19WP.			
Sections ..... „	3	4	
Split tube			
19 S.W.G. (¼") ..... „	4	2	
20 S.W.G. (⅜") ..... „	3	11	
21 S.W.G. (½") ..... „	4	1	
22 S.W.G. (¾") ..... „	4	11	
Welded tube			
14 to 20 S.W.G. (sizes ½" to 1½") .... „	3/10½ to 5/8½		

Brass			
Tubes ..... lb.	1	9½	
Brazed Tubes ..... „	3	2½	
Drawn Strip Sections „	3	2½	
Sheet ..... ton	200	5	0
Strip ..... „	200	5	0
Extruded Bar ..... lb.	2	0½	
Condenser Plate (Yellow Metal)..... ton	188	0	0
Condenser Plate (Naval Brass) ..... „	200	0	0
Wire ..... lb.	2	8½	
Beryllium Copper			
Strip ..... „	1	4	11
Rod ..... „	1	1	6
Wire ..... „	1	4	9
Copper			
Tubes ..... lb.	2	1⅞	
Sheet ..... ton	259	5	0
Strip ..... „	259	5	0
H.C. Wire ..... „	276	5	0
Cupro Nickel			
Tubes 70/30 ..... lb.	3	6½	

Lead			
Pipes (London) ..... ton	107	0	0
Sheet (London) ..... „	104	15	0
Tellurium Lead ..... „	£6 extra		
Nickel Silver			
Sheet and Strip 10%.. lb.	3	10½	
Wire 10% ..... „	4	3½	
Phosphor Bronze			
Wire ..... „	4	1	
Titanium (1,000 lb. lots)			
Billet 4½" to 18" dia..... lb.	47/-	48/-	
Rod ¼" to 4" dia..... „	85/-	53/-	
Wire ·036"-232" dia.... „	159/-	99/-	
Strip ·001" to ·048".... „	350/-	68/-	
Sheet 8'×2'. 20 gauge „	73/-		
Tube, representative average gauge ..... „	198/-		
Extrusions ..... „	90/-		
Zinc			
Sheet ..... ton	124	10	0
Strip ..... „	nom.		

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 14/3/61.

Aluminium	£
New Cuttings	141
Old Rolled	114
Segregated Turnings	78
Brass	
Cuttings	158
Rod Ends	143
Heavy Yellow	135
Light	130
Rolled	148
Collected Scrap	134
Turnings	137
Copper	
Wire	203
Firebox, cut up	200
Heavy	198
Light	195
Cuttings	205
Turnings	182
Braziery	175

Gunmetal	£
Gear Wheels	200
Admiralty.....	200
Commercial	182
Turnings	177
Lead	
Scrap	57
Nickel	
Cuttings	—
Anodes	555
Phosphor Bronze	
Scrap	182
Turnings	177
Zinc	
Remelted	76
Cuttings	64
Old Zinc	44

Financial News

Albright and Wilson

It is reported that the offer by Albright and Wilson for the capital of W. J. Bush and Co. has been accepted by holders of more than 92 per cent of each class of shares, and has become unconditional in respect of all three classes. Late acceptances will continue to be received.

Cambridge Instrument Co. Ltd.

Group net profit 1960 £283,593 (£256,965) and dividend 22 per cent (equivalent 20·41 per cent). Fixed assets £862,743 (£733,670), investments in unconsolidated subsidiaries £188,150 (same) and net current assets £1,534,010 (£1,248,118). Capital commitments £150,000 (£23,000).

Norton Industries

Group net profit year to October 31, 1960, £109,513 (£87,535), dividend 20 per cent (equivalent 10 per cent, and distribution equal to 1·625d. net per 2s. share). Fixed assets £402,712 (£371,954), current assets £1,021,193 (£968,749) and liabilities £767,352 (£736,972).

Irish Aluminium

Net profit 1960, £19,213 (£17,917) and dividend 13 per cent, tax free (same). Fixed assets £106,604 (£104,750), current assets £265,608 (£247,760) and liabilities £169,926 (£164,299), including £36,824 (£26,416) due to bank.

Lydenburg Platinum

Group net profit year ended October 31, 1960, £236,615 (£147,759 for 14 months) after administration £31,362 (£37,045), interest £23,121 (£26,438) and net loss on sale of stands £14,192 (profit £4,708). Dividends paid 27½ per cent (16½ per cent for period), £247,500 (£150,000), off mineral rights £38,881 net (nil), forward £28,673 (£42,312). Investments £582,468 (£596,492) with market value £1,570,938 (£1,886,128), property and township interests £892,375 (£900,558), development expenditure recoverable £136,426 (£131,236) and debtors for stands and houses sold £598,263 (£705,413). Current assets £284,854 (£207,630) and liabilities £311,027 (£301,770), including bank overdraft £122,612 (£123,833). Secured liabilities £409,523 (£421,284) and provisions £367,000 (£479,750).

F. W. Berk and Co. Ltd.

It is reported that Berk and Company have now entered into a conditional agreement to acquire all the 1,076,000 Ordinary 5s. shares of the St. Albans Sand and Gravel Company from Alluvial and General Industries (London). The consideration is the allotment to Alluvial of 1,000,000 Ordinary 5s. shares of Berk. The Ordinary shares in St. Albans will be acquired as from January 1, 1961, and Berk will be entitled to all dividends declared or paid after that date, except the £38,000 interim paid March 2 last, in respect of 1960.

LIGHT METALS STATISTICS IN JAPAN
(November 1960)

Classification	Production	Shipment	Stock	Export
Alumina	32,105	38,659	12,303	14,972
Super purity Al	171	97	580	0
Primary Al	11,567	11,576	7,208	0
Secondary Al	4,571	4,478	713	0
Wrought products (Al and its alloy)	11,683	11,821	3,322	919
Plate, sheet and strip	8,116	8,534	2,345	821
Foil	773	843	262	821
Rolled and extruded shape	1,744	1,737	284	821
Forgings	37	—	—	—
Electric wire	1,013	707	431	98
Powder, flake and paste	—	—	—	—
Casting	6,124	—	—	—
Sand and permanent mould	3,360	—	—	—
Die	2,764	—	—	—
Sheet products	2,145	2.248	1,588	38
Primary Mg	214	211	29	—
Secondary Mg	226	227	404	—
Mg casting	33	—	—	—
Sponge Ti	189	176	1,024	169
Super purity Al (Dec.)	143	62	661	0
Primary Al (Dec.)	11,819	12,476	6,552	0

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

France (new francs per kilo):

Electrolytic copper scrap	(£225.7.0) 3.05
Heavy copper	(£225.7.0) 3.05
No. 1 copper wire	(£208.7.0) 2.82
Brass rod ends	(£164.1.0) 2.22
Zinc castings	(£65.0.0) 0.88
Lead	(£64.5.0) 0.87
Aluminium	(£134.9.0) 1.82

Italy (lire per kilo):

Aluminium soft sheet clippings (new)	(£178.2.0) 305
Lead, soft, first quality	(£80.0.0) 137
Lead, battery plates	(£44.19.0) 77
Copper, first grade	(£216.1.0) 370
Bronze, commercial gunmetal	(£175.4.0) 300
Brass, heavy	(£148.18.0) 255
Brass, light	(£134.6.0) 230
Brass, bar turnings	(£148.18.0) 255
Old zinc	(£61.6.0) 105

Japan (Yen per metric ton):

Electrolytic copper	(£—)	275,000
Copper wire No. 1	(£—)	262,000
Copper wire No. 2	(£—)	247,000
Heavy copper	(£—)	245,000
Light copper	(£—)	205,000
Brass, new cuttings	(£—)	185,000
Red brass scrap	(£—)	212,000

West Germany (D-marks per 100 kilos):

Used copper wire	(£218.12.0) 240
Heavy copper	(£209.10.0) 230
Light copper	(£182.4.0) 200
Heavy brass	(£132.1.0) 145
Light brass	(£95.13.0) 105
Soft lead scrap	(£52.16.0) 58
Zinc scrap	(£52.16.0) 58
Used aluminium unsorted	(£81.19.0) 90

Trade Publications

Nitrogen / Hydrogen Mixtures. — The Incandescent Heat Company Ltd., Cornwall Road, Smethwick, Birmingham.

A new leaflet has been produced to describe a new process which uses blast furnace gas to produce a nitrogen/hydrogen mixture which, it is said, can replace coke oven gas in the heat-treatment of steel.

Electroplating. — W. Canning and Co. Ltd., Great Hampton Street, Birmingham, 18.

A supplement to the "Canning Handbook on Electroplating" has just been published and contains information on recent developments in polishing and electroplating and should be read in conjunction with the 19th edition of the handbook. A news sheet (number 15a) has also been published dealing with the Canning nickel solution 296 for corrosion resistant deposits. This plating solution has been specially developed to give a deposit which combines excellent corrosion resistance with maximum levelling.

Blast Furnaces.—Ashmore, Benson, Pease and Company Ltd., P.O. Box 17, Stockton-on-Tees.

The third edition of a brochure illustrating the blast furnace plants made by this company has just been published and coincides with instructions to build their fiftieth modern plant. This latest unit is to be built for the Ford Motor Company Limited which, by a happy coincidence, gave the company its first order for a blast furnace. In its 56 pages, the brochure outlines in text and illustrations the plants which have been built by the company for many industrial concerns both at home and overseas.

Technical Data Sheet.—Croda Limited, Cowick Hall, Snaith, Goole, Yorks.

This loose-leaf brochure introduces "Dricote", a rust preventive which does not need to be removed before paint is applied. Its composition and properties, function, manipulation, etc., are detailed, and also its various uses.

Metal Cleaning.—Diversey (U.K.) Ltd. (Metal Industries Division), 42-46 Weymouth Street, London, W.1.

A set of leaflets dealing with the compounds produced by this company have been issued as follows: No. 17 is designed for soak cleaning of aluminium; No. 202 is a fast-working, highly efficient product for the cleaning of aluminium; No. 514 is a cold de-oxidizer—an acid-type compound in the form of tiny, dustless crystals, for aluminium processing; No. 519 is a spray cleaner for ferrous and non-ferrous alloys; No. 600 is a de-oxidizer designed especially to remove oxide from heavily heat-treated aluminium stock prior to spot-welding; No. 808 is a non-etching, heavy duty alkaline cleaner for quick, economical soil removal from all aluminium alloys; and "Aluminux" is for uniform satin etch on all aluminium alloys.

Electric Furnaces.—Metalectric Furnaces Ltd., Cornwall Road, Smethwick, 40, Staffs.

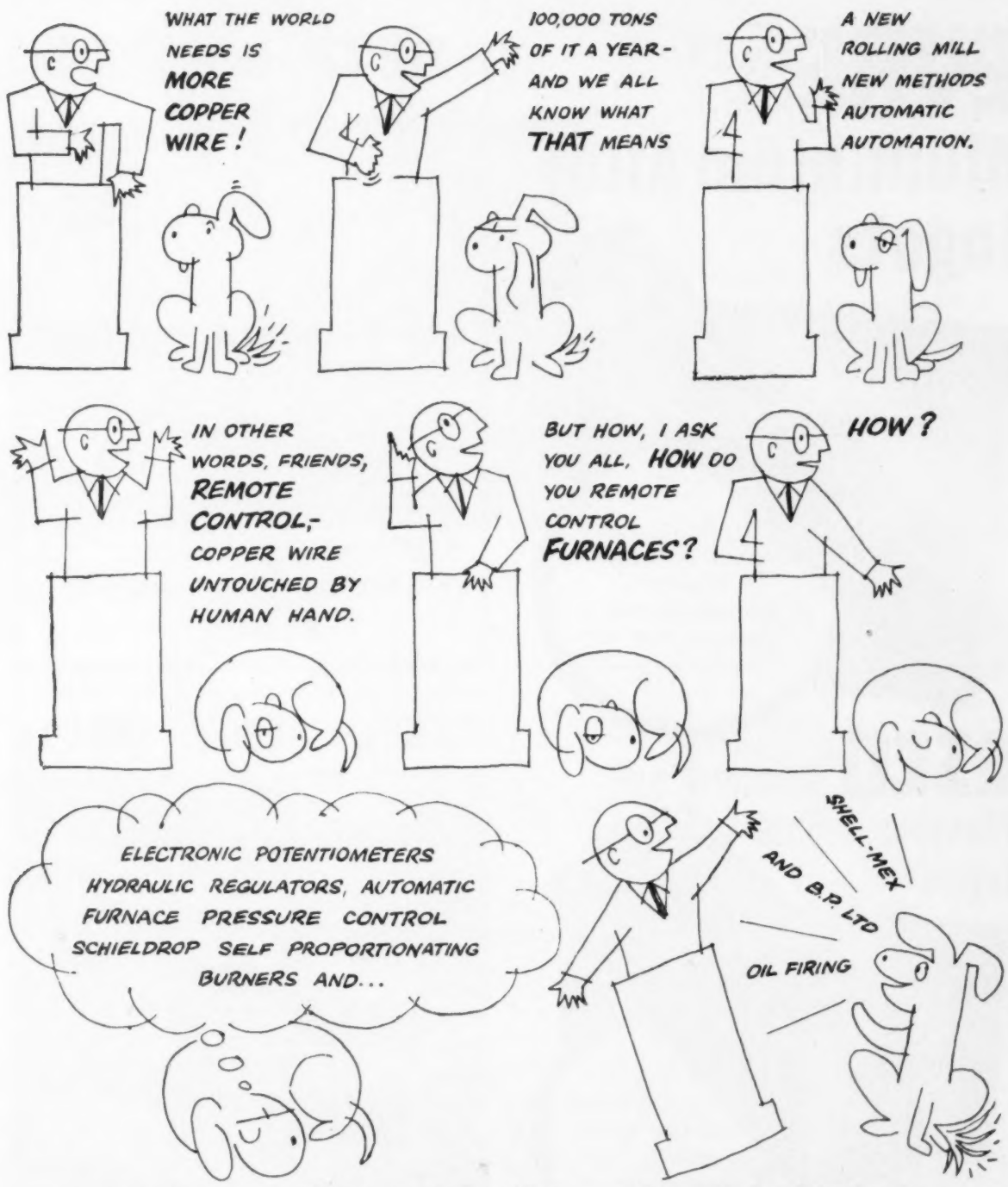
Bulletin No. M.1, just issued, deals with electric furnaces for all industries. Details are given of continuous furnaces, electric melting furnaces, heavy duty furnaces, controlled atmosphere furnaces, and standard units. A number of illustrations are included.

THE STOCK EXCHANGE

Turnover Fairly Well Maintained But Easier Tendency In Places

ISSUED CAPITAL *	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 13 MARCH	+RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1960-61 HIGH	1960-61 LOW	1959 HIGH	1959 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	32/6	+1/-	11	9	6 15 6	34/9	25/6	33/3	23/3
400,000	2/-	Anti-Attrition Metal	1/-		NIL	4	NIL	1/6	0/9	1/7½	1/-
43,133,593	Stk. (£1)	Associated Electrical Industries ...	48/3	+1/6	15	15	6 4 6	67/3	39/3	67/-	54/-
3,895,963	1	Birfield	50/3	—1/-	10	15‡	3 19 6	52/-	29/-	75/4½	46/-
4,795,000	1	Birmid Industries	84/3	+2/6	20	20D	4 15 3	84/3	56/-	75/6	46/9
8,445,516	Stk. (10/-)	Birmingham Small Arms	32/9	—9d.	17½QT	12½	3 14 0	33/6	18/4½	69/-	36/-
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	14/6		5	5	6 18 0	17/4½	14/4½	17/6	15/-
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/9	—3d.	6	6	7 3 3	20/-	16/6	20/1½	17/9
500,000	1	Bolton (Thos.) & Sons	48/9		12½	10	4 6 6	48/9	37/-	47/-	27/6
300,000	1	Ditto Pref. 5%	14/-		5	5	7 2 9	16/-	13/6	16/-	14/9
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	17/-		6	6	7 1 3	21/1½	16/7½	21/6	18/9
18,846,647	Stk. (£1)	British Insulated Callender's Cables	57/3	—6d.	13½	13½	4 14 3	61/-	47/6	61/-	45/1½
20,456,599	5/-	British Oxygen Co. Ltd., Ord. ...	30/-	—6d.	16	16	2 13 3	34/6	19/6	87/9	49/3
1,200,000	Stk. (5/-)	Canning (W.) & Co.	17/-	—2/-	15+8⅛C	25+ *2½C‡	4 8 3	20/-	13/3	18/1½	12/3
60,484	1/-	Carr (Chas.)	1/4½	—1½d.	NIL	12½	—	2/3	1/-	2/10½	1/3
555,000	1	Clifford (Chas.) Ltd.	28/-	—9d.	10	10	7 2 9	35/-	26/-	30/-	22/6
45,000	1	Ditto Cum. Pref. 6%	15/3		6	6	7 17 6	16/-	15/3	16/-	17/-
300,000	2/-	Coley Metals	4/-	—3d.	15	15	7 10 0	5/-	3/3	4/6	2/6
10,185,696	1	Cons. Zinc Corp.†	69/6	+2/3	20	15	5 15 0	80/-	60/6	77/3	57/9
5,399,056	1	Davy-Ashmore	165/6	+7/3	30‡	20	1 16 3	165/3	100/6	116/-	43/-
8,000,000	5/-	Delta Metal	23/6	+6d.	17½	31‡	3 14 6	28/-	18/7½	26/4½	11/6
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	48/6	+2/3	15	15	6 3 9	56/3	45/-	61/9	36/7½
1,155,000	1	Evered & Co.	44/-		10B	10φ	3 0 0	44/-	29/-	42/6	30/-
18,000,000	Stk. (£1)	General Electric Co.	38/6	+1/6	10	10	5 4 0	51/6	29/3	50/6	30/-
1,500,000	Stk. (10/-)	General Refractories Ltd.	57/9	+4/9	25	20	4 6 6	58/-	40/-	47/-	31/4½
1,037,492	5/-	Glacier Metal Co. Ltd.	16/-	+1/-	13	11½	4 1 3	16/1½	11/1½	11/3	6/7½
2,500,000	5/-	Glynwed Tubes	24/3	+3d.	25¶	20	3 10 0	27/1½	17/7½	30/9	16/1½
7,228,065	10/-	Goodlass Wall & Lead Industries ...	40/3	—9d.	19L	16	3 10 9	41/9	33/4½	53/-	28/7½
696,780	10/-	Greenwood & Batley	25/-xcap		30W	30	6 0 0	27/-	23/9Z	130/-	75/-
792,000	5/-	Harrison (B'ham) Ord.	13/6	+7½d.	*20‡	*17½	3 14 0	15/4½	11/9	26/9	14/-
150,000	1	Ditto Cum. Pref. 7%	20/-		7	7	7 0 0	20/-	19/3	19/6	19/4½
1,612,750	5/-	Heenan Group	15/4½	+7½d.	13	15	4 4 6	15/4½	10/-	19/6	7/4½
251,689,407	Stk. (£1)	Imperial Chemical Industries ...	70/6	—1/3	11½N	8	3 3 9	75/3	54/-	62/7½	33/1½
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	15/6	—3d.	5	5	6 9 0	17/9	15/3	19/1½	15/6
29,184,044	**	International Nickel	122½		$1.60	$1.50	2 8 0	123	85½	201½	154½
300,000	1	Johnson, Matthey & Co. Cum. Pref 5%	14/3		5	5	7 0 3	16/6	13/9	17/6	14/9
6,000,000	1	Ditto Ord.	6/3	+1/-	12	12D	3 18 6	66/6	45/-	50/3	27/3
600,000	10/-	Keith, Blackman	20/9	+6d.	17½	17½E	8 8 9	32/6	17/9	32/-	25/-
320,000	4/-	London Aluminium	10/4½	—3d.	12	10	4 11 9	12/6	7/6	10/7½	5/3
765,012	1	McKechnie Bros. Ord	53/9	—3d.	17½F	15F	6 10 3	71/6	53/6	62/6	39/9
1,530,024	1	Ditto A. Ord	53/3	+9d.	17½F	15'	6 11 6	69/3	52/6	65/6	38/9
1,108,268	5/-	Manganese Bronze & Brass	16/3	+6d.	20⅝	20⅝	6 13 3	18/9	13/4½	19/-	13/6
50,628	6/-	Ditto (7½% N.C Pref.)	5/9	—3d.	7½	7½	7 10 6	6/6	5/6	7/9	5/9
26,361,444	Stk. (£1)	Metal Box	85/-	+6d.	12M	13B	2 11 6	85/-	55/9	80/-	44/7½
415,760	Stk. (2/-)	Metal Traders	8/-	+9d.	50	50	12 10 0	10/4½	7/1½	13/6	8/4½
160,000	1	Mint (The) Birmingham	36/9		10	10	5 8 9	39/-	33/6	35/-	22/-
80,000	5	Ditto Pref. 6%	76/3		6	6	7 17 6	80/-	75/-	80/-	69/-
5,187,938	Stk. (£1)	Morgan Crucible A	60/6	+9d.	13	12	4 6 0	62/3	47/6	52/6	30/-
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	16/-		5½	5½	6 17 6	18/6	15/4½	19/3	17/3
3,850,000	Stk. (£1)	Murex	43/6	+9d.	22½J	15	5 14 3	45/-	35/3	76/4½	41/-
585 000	5/-	Ratcliffs (Great Bridge) Ord. ...	16/-		10	10R	3 2 6	17/-	14/9	—	
195 000	5/-	Ditto 8% Max. Ord.	5/-		8	—	8 0 0	5/3	5/-	—	
1,064,880	10/-	Sanderson Kayser	38/-		35‡	25	4 12 3	40/3	27/7½	56/-	27/9
3,400,500	Stk. (5/-)	Serck	17/3	—6d.	12½	17½GD	3 12 6	25/-	15/3	26/-	12/-
8,035,372	Stk. (£1)	Stone-Platt Industries	66/-		15	15	4 11 0	66/6	52/3	63/6	42/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	15/-		5½	5½	7 6 9	18/7½	15/-	18/9	15/10½
35,344,881	Stk. (£1)	Tube Investments Ord.	79/9	—9d.	14	20	3 10 3	95/9	66/3	138/-	71/7½
41,000,060	Stk. (£1)	Vickers	31/6	—6d.	10	10	6 7 0	39/-	27/3	40/6	26/10½
750.000	Stk. (£1)	Ditto Pref 5%	13/-		5	5	7 13 9	17/6	14/-	17/3	14/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	20/6		*5	*5	7 7 6A	24/3	20/-	25/9	20/6
4,594,418	1	Ward (Thos. W.) Ord.	74/3	+1/3	13¾	25	3 16 9	86/-	64/-	167/6	83/-
7,109,424	Stk. (£1)	Westinghouse Brake	40/6		11	10	5 8 9	59/9	36/6	60/7½	39/-
315,895	2/-	Wolverhampton Die-Casting ...	9/10½	+1½d.	35	30	7 1 9	13/10½	8/3	13/1½	8/8½
591,000	5/-	Wolverhampton Metal	29/3	+1/6	32½	27½	5 11 0	39/6	23/9	34/3	21/6
156,930	2/6	Wright, Bindley & Gell	4/1½		15	20‡	9 1 9	4/3	2/10½	4/3	2/6
124,140	1	Ditto Cum. Pref. 6%	13/6		6	6	8 17 9	15/3	13/3	14/3	12/10½
150,000	1/-	Zinc Alloy Rust Proof	5/-		40	30	8 0 0	5/6	4/-	3/10½	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% capitalized issue. ⊕The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. D and 50% capitalized issue. C paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. R and 33⅓% capitalized issue in 8% Maximum Ordinary 5/- Stock Units. φ and 6½% from Capital Profits B and 50% capitalized issue. G and 1½d. special distribution. F and special 5% tax free dividend. H As forecast. ¶And 3 for 7 capitalized issue. L and 33⅓% capitalized issue. M and 10% capitalized issue. N Interim since increased. J and 75% capitalized issue. S and 40% capitalized issue. O calculated at 13⅓%. Interim on smaller capital P Calculated at 11⅓%. Q also 1/- special tax free dividend and 50% capitalized issue. T Per £1 unit. W Before capital reorganization. Calculated at 15%. Z After capital reorganization



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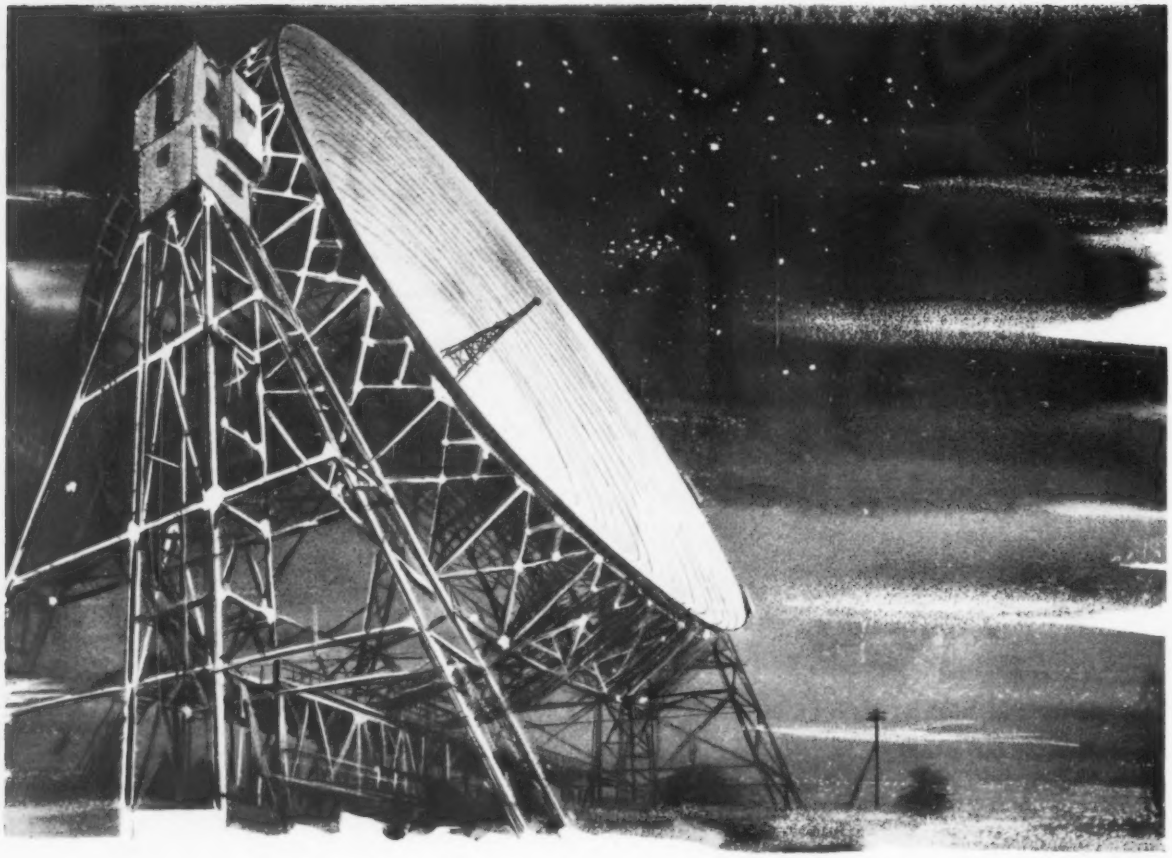

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